

Visual Diagnosis in Emergency and Critical Care Medicine

"To my wife Angela and to my 6 children (Erik, Elijah, Benjamin, Samuel, Noah, and Annalee) who routinely consent to my photographing their various ailments and injuries for inclusion in this book." CPH

"To my wife and children who have always supported and inspired me." ABB

"To my supportive family – Lori, Asher, and Molly." JMP

"My thanks and love to my family, King, Lauren, Anne, Chip, and Katherine." WJB

Visual Diagnosis in Emergency and Critical Care Medicine

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SECOND EDITION



WILEY-BLACKWELL

A John Wiley & Sons, Ltd., Publication

BMJ|Books

This edition first published 2011, © 2006, 2011 by Blackwell Publishing Ltd

BMJ Books is an imprint of BMJ Publishing Group Limited, used under licence by Blackwell Publishing which was acquired by John Wiley & Sons in February 2007. Blackwell's publishing programme has been merged with Wiley's global Scientific, Technical and Medical business to form Wiley-Blackwell.

Registered office: John Wiley & Sons, Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

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ISBN: 978-1-444-333473

A catalogue record for this book is available from the British Library.

This book is published in the following electronic formats: ePDF 9781444397987; Wiley Online Library 9781444397994; ePub 9781444398007

Set in 9.25/12pt Palatino by Toppan Best-set Premedia Limited, Hong Kong

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Foreword

This book stakes out a slightly different position from most educational publications. I believe it reaches a higher level, accomplishing more for the reader. Unlike the many texts that provide a compendium of information, this one presents cases, images, and information together in a way that parallels a clinical encounter. The work apparently intends to both enhance knowledge and also provide virtual experiences. In doing so perhaps it even helps advance the expertise of the reader. Each case is presented in a succinct paragraph accompanied by a high-quality visual image. Then a question is asked. Answers are accompanied by a detailed explanation that is longer than the case itself. The format seems simple, but it is effective, even powerful. It made me want to pick it up and read.

It takes over a decade of medical studies to become an expert physician. The journey requires relentless effort, with lots of reading, meaningful engagement in clinical situations, guidance from experts, and constructive feedback. This book offers all of this. It offers something for everyone, including even experts and teachers themselves. As teachers, we all can learn from the way the information is presented in this book. It displays the best attributes of expert teaching material. The cases are relevant and real; important questions are asked; “must-know” facts are presented. There is no excessive language or lengthy prose. The pace keeps moving. There is nothing dense to bog the reader down. This is the kind of teaching that students of all levels can enjoy.

On the journey toward expertise, a novice memorizes facts, confronts new experiences, tries to organize information, and, at first, relies heavily on short-term memory. After thousands of focused encounters, hundreds of hours of reading, timely feedback, and, crucially, guidance by experts, the novice grows to become expert. It is not an easy climb. Motivation is as important as innate skill and intellect since the work is hard. Given the length and the difficulty of the path, it is wonderful to have this teaching material, beautifully constructed, to make some of the necessary reading and memorization interesting. This kind of work will accelerate learning.

Beyond the novice, this work helps move all of us lifelong learners farther forward toward greater expertise. Each brief, salient case gives rich information that automatically triggers the expert reader. Sometimes we know

immediately what the case is about, sometimes we do not. Even as we read just the title of each case we begin to frame, or even try to diagnose, the problem. This will be natural for experienced physicians. Even when the answer is known, the case offers much additional information. The visual images are clear, compelling, and classic. Many of the cases will be variations of diagnoses that we have seen, some are unique, and all function as a high-yield clinical encounter. Every condition is central to our practice. A key question follows each case description, presenting a challenge, testing our knowledge and judgment. Some questions were easy, some were not. I have to admit that I enjoyed getting questions right, but even then I learned something more in the detailed answer. The answer set provides in-depth explanations that help us learn or relearn what we need to know.

Novices will move more slowly through the book, will encounter cases that are new to them, and will have the opportunity to mentally embed the images, along with the knowledge and facts. The relevance could not be greater. The work is visually engaging, the writing segments are brief, and the information is concentrated. The cases are not organized by organ system; they are presented in the way that an emergency physician encounters each case, as a complete unknown. At any speed, the readers’ energy and interest is kept high.

Learning is most engaging and most efficient when well guided. Each case encapsulates critical information. I am told by expert educators and cognitive scientists that, in medical education, the human mind first uses short-term memory to recall facts but, with cumulative, guided experiences, begins to integrate the facts with the patterns of disease, and the visual imagery. All this moves mysteriously into long-term memory. This long-term memory subsequently enables our quick, automatic response to a case or clinical situation. This quick reaction is familiar to all of us who have been practicing any length of time. We often can make a key, visual diagnosis within seconds. We can develop an accurate therapeutic plan within minutes. We also take time to attend to the subtleties, variations, and clinical cues that indicate we may need to consider other possibilities. It seems very tricky when described, but quite natural in practice. A hallmark of experts is this speed with which patterns are recognized. When asked,

"How did you know?" the expert has a difficult time explaining. The skill resides in parts of the brain where language does not. As learners move along the continuum to development of expertise, this book will help with both the short-term facts and the embedding into long-term memory.

It seems to me that this book does much more than present information, it serves as a trainer for those of us who aspire to be better at what we do. Every expert requires constructive challenges, a coach to provide feedback, help correct us and, perhaps even to inspire us to maintain our motivation. The book does all this for me,

and is perhaps the next best thing to a live devoted teacher. It is ideal for residents and a pleasure for the experienced physician. It is designed by expert educators and expert emergency physicians who provide rich material, present a challenge, and then provide feedback and critical facts that helps us move forward toward that mysterious attribute called expertise.

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Preface

The acute care practitioner faces numerous challenges in the approach to the critically ill or injured patient. Clearly, the history of the event is a vital portion of the evaluation, providing the “answer” to the clinical situation in many instances. The physical examination and the results of various diagnostic investigations, however, are also essential components of the medical evaluation. In fact, the examination, the electrocardiogram, and the radiograph provide the clinician with either the diagnosis or important information which will lead to the diagnosis. The rash of erythema multiforme, the electrocardiogram in pronounced hyperkalemia, the radiograph in carpometacarpal dislocation are all presentations where a single “clinical image” provides the immediate diagnosis or a substantial clue that leads to the correct diagnosis, with appropriate therapy subsequently following. Bed-side clinical diagnosis, based upon specific clinical images, is a vital skill for the acute care practitioner.

The purpose of this book is to provide some of those visual diagnostic clues that might be encountered in acute

care scenarios. Each visual cue is associated with an actual case and a multiple choice question. The correct answer and a focused discussion then follow. In academic practice, utilizing a visual cue with an associated case presentation and a multiple choice question is a highly effective teaching method. In clinical practice, the use of case-based scenarios is a popular, effective means of self-education. This enables the teacher or the student to discuss the disease – and importantly the diagnosis and management. We have attempted to capture this teaching style within the context of this book. Whether you are an experienced clinician in private practice, an academician engaged in teaching, a resident or student in training looking to prepare for tests, we hope this book will provide you with further experience to excel as a practitioner in the field of medicine.

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Illustration credits

- 1) **Slash Wound to the Neck.** Case: Alexander B. Baer
- 2) **I've got Blood in My Eye.** Case: Chris S. Bergstrom; Figure Chris S. Bergstrom
- 3) **Forearm Fracture after Falling.** Case: Alexander B. Baer; Figure 1: Alexander B. Baer
- 4) **Neonate with Fever and Rash.** Case: Alexander B. Baer
- 5) **A Missing Button Battery.** Case: Sarah G. Winters; Figure 1: Brendan G. Carr; Figure 2: Christopher P. Holstege; Figure 3: Brendan G. Carr; Figure 4: Brendan G. Carr; Figure 5: Brendan G. Carr
- 6) **Anorexia, Hair Loss, and Fingernail Bands.** Case: Christopher P. Holstege; Figure 1: Christopher P. Holstege
- 7) **Wide Complex Tachycardia in a Young Adult.** Case: William J. Brady; Figure 1: William J. Brady
- 8) **Wide Complex Tachycardia in an Older Male Patient.** Case: William J. Brady; Figure 1: William J. Brady; Figure 2: William J. Brady
- 9) **Muscle Spasms Following a Spider Bite.** Case: Christopher P. Holstege
- 10) **Necrotic Skin Lesion.** Case: Kenneth A. Katz
- 11) **Intense Pain following High-pressure Injection injury.** Case: Alexander B. Baer; Figure 1: Alexander B. Baer
- 12) **Prenatal Vitamin Overdose.** Case: Christopher P. Holstege; Figure 1: Christopher P. Holstege; Figure 2: Christopher P. Holstege
- 13) **Blurred Vision Following Yard Work.** Case: Alexander B. Baer; Figure 1: Christopher P. Holstege
- 14) **Foot Pain in a Gymnast.** Case: Alexander B. Baer; Figure 1: Alexander B. Baer
- 15) **Child with Bruises of Different Ages.** Case: Christopher P. Holstege
- 16) **Sudden Shortness of Breath after Removal of a Central Line.** Case: Christopher P. Holstege; Figure 1: Christopher P. Holstege; Figure 2: Christopher P. Holstege
- 17) **My Eyes are Yellow.** Case: Alexander B. Baer
- 18) **Pleuritic Chest Pain in a Young Adult Male.** Case: William J. Brady
- 19) **Exposed During a Blizzard.** Case: Alexander B. Baer
- 20) **FAST Evaluation of a Trauma Patient.** Case: Anthony J. Dean; Figure 1: Anthony J. Dean; Figure 2: Anthony J. Dean; Figure 3: James H. Moak; Figure 4: James H. Moak
- 21) **Chest Pain with Sudden Cardiac Death.** Case: William J. Brady
- 22) **Wrist Sprain in a Child.** Case: Alexander B. Baer; Figure 1: Alexander B. Baer
- 23) **Acute Eye Pain and Blurred Vision in an Elderly Female.** Case: Chris S. Bergstrom
- 24) **Heel Pain Following a Fall.** Case: Alexander B. Baer; Figure 1: Alexander B. Baer
- 25) **Confluent Rash on a Child.** Case: Brendan Carr
- 26) **Bradycardia Following an Herbal Ingestion.** Case: Christopher P. Holstege
- 27) **Painfree Adult with Persistent T Wave Abnormalities.** Case 1: William J. Brady; Figure 1: William J. Brady; Figure 2: William J. Brady
- 28) **Caustic Ingestion with Cardiotoxic Effects.** Case: Christopher P. Holstege
- 29) **Chemical Eye Exposure.** Case: Chris S. Bergstrom
- 30) **Acute Abdominal Pain in Pregnancy.** Case: Anthony J. Dean; Figure 1: Anthony J. Dean; Figure 2: Anthony J. Dean; Figure 3: James H. Moak
- 31) **Coma Following Head Trauma.** Case: Alexander B. Baer
- 32) **Tongue Swelling in a Hypertensive Female.** Case: Christopher P. Holstege; Figure 1: Christopher P. Holstege
- 33) **Purulent Eye Discharge in an Adult.** Case: Chris S. Bergstrom
- 34) **Shoulder Pain Following Direct Blow.** Case: Alexander B. Baer; Figure 1: Alexander B. Baer
- 35) **Gagging Child.** Case: Christopher P. Holstege
- 36) **Adult Male with a Sudden, Severe Headache.** Case: Alexander B. Baer
- 37) **New Facial Droop.** Case: Alexander B. Baer
- 38) **Eye Pain after Tree Branch Strike.** Case: Chris S. Bergstrom
- 39) **Elderly Woman with Groin Pain.** Case: Alexander B. Baer
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- 41) **Radiology Findings after Laparoscopy.** Case: Munish Goyal
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- 43) **"Pinkeye" in a Contact Lens Wearer.** Case: Chris S. Bergstrom
- 44) **Suspicious Hand Pain.** Case: Alexander B. Baer; Figure 1: Alexander B. Baer
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- 46) **An Alcoholic with Dyspnea.** Case: Anthony J. Dean; Figure 1: Anthony J. Dean; Figure 2: Anthony J. Dean; Figure 3: Anthony J. Dean; Figure 4: Anthony J. Dean
- 47) **Dark Urine from an Immigrant.** Case: William H. Shoff; Figure 1: Suzanne M. Shepherd
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- 49) **Hand Pain after Striking Wall.** Case: Alexander B. Baer; Figure 1: Alexander B. Baer
- 50) **A Refugee with Skin Lesions.** Case: Edward T. Dickinson
- 51) **Pain out of Proportion to Examination.** Case: Robert M. Underwood
- 52) **Leg Pain Following a Motor Vehicle Collision.** Case: Alexander B. Baer; Figure 1: Alexander B. Baer
- 53) **Deformed Globe Following Trauma.** Case: Chris S. Bergstrom
- 54) **Foot Pain Following Breaking.** Case: Alexander B. Baer
- 55) **Lamp Oil Ingestion.** Case: Christopher P. Holstege
- 56) **Intermittent Abdominal Pain in a Female.** Case: Anthony J. Dean; Figure 1: Anthony J. Dean
- 57) **Hallucinations in a Botanist.** Case: Christopher P. Holstege & Alexander B. Baer
- 58) **Altered Mental Status with an Abnormal Electrocardiogram.** Case: William J. Brady; Figure 1: William J. Brady; Figure 2: William J. Brady
- 59) **Fishing in the Stomach.** Case: Christopher P. Holstege; Figure 1: Christopher P. Holstege
- 60) **Overdose-induced Boiled Lobster Skin.** Case: Christopher P. Holstege; Figure 1: Christopher P. Holstege; Figure 2: Christopher P. Holstege
- 61) **Back Pain Following a Fall.** Case: Alexander B. Baer; Figure 1: Alexander B. Baer
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- 63) **Intense Wrist Pain Following Trauma.** Case: Alexander B. Baer; Figure 1: Alexander B. Baer
- 64) **Fever and Drooling in a Child.** Case: Alexander B. Baer
- 65) **Syncope and Flank Pain in an Elderly Man.** Case: Anthony J. Dean; Figure 1: Anthony J. Dean; Figure 2: Anthony J. Dean
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- 67) **A "Blue Hue" Following Endoscopy.** Case: Christopher P. Holstege; Figure 1: Christopher P. Holstege
- 68) **Acute Onset Blurred Vision.** Case: Chris S. Bergstrom; Figure 1: Chris S. Bergstrom; Figure 2: Chris S. Bergstrom; Figure 3: Chris S. Bergstrom; Figure 4: Chris S. Bergstrom
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- 70) **Confusion, Anemia, and Abdominal Pain in a Toddler.** Case: Christopher P. Holstege; Figure 1: Christopher P. Holstege
- 71) **Ground-level Fall with Ankle Pain.** Case: Alexander B. Baer; Figure 1: Alexander B. Baer
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- 73) **Diffuse Ankle Pain Following a Fall.** Case: Alexander B. Baer; Figure 1: Alexander B. Baer
- 74) **Rash Following Brush Fire.** Case: Christopher P. Holstege; Figure 1: Christopher P. Holstege; Figure 2: Christopher P. Holstege
- 75) **Abdominal Pain in a Trauma Victim.** Case: Alexander B. Baer
- 76) **Skin Target Lesion.** Case: Carlos Rosé
- 77) **Chest Pain and a Confounding Electrocardiogram Pattern.** Case: William J. Brady; Figure 1: William J. Brady
- 78) **Sudden Sedation in a Student.** Case: Alexander B. Baer
- 79) **Skin Lesions in a Comatose Patient.** Case: Christopher P. Holstege; Figure 1: Christopher P. Holstege
- 80) **Raccoon Eyes.** Case: Alexander B. Baer
- 81) **Fall on an Outstretched Hand in a Young Adolescent.** Case: William J. Brady; Figure 1: William J. Brady; Figure 2: William J. Brady
- 82) **Eye Pain and Facial Swelling.** Case: Alexander B. Baer; Figure 1: Chris S. Bergstrom; Figure 2: Chris S. Bergstrom
- 83) **Wrist Pain Following Fall on an Outstretched Hand.** Case: Alexander B. Baer; Figure 1: Alexander B. Baer; Figure 2: Alexander B. Baer
- 84) **Rash on a Child with Epilepsy.** Case: Christopher P. Holstege; Figure 1: Christopher P. Holstege; Figure 2: Christopher P. Holstege
- 85) **Abdominal Pain in an Alcoholic.** Case & Figure: Alexander B. Baer
- 86) **Chest Pain with Electrocardiographic ST Segment & T-Wave Abnormalities.** Case: William J. Brady; Figure 1: William J. Brady
- 87) **Heroin Abuser with Multiple Skin Lesions.** Case: Alexander B. Baer; Figure 1: Alexander B. Baer; Figure 2: Alexander B. Baer; Figure 3: Alexander B. Baer; Figure 4: Christopher P. Holstege

- 88) **Chest Pain in a Middle-aged Male Patient with ST Segment Elevation.** Case: William J. Brady; Figure 1: William J. Brady
- 89) **Fire Victim with Hoarseness.** Case: Christopher P. Holstege; Figure 1: Christopher P. Holstege
- 90) **Gardener with a Non-Healing Rash.** Case: Steve Larson
- 91) **Bite to the Leg in Tall Grass.** Case: Alexander B. Baer; Figure 1: Christopher P. Holstege; Figure 2: Christopher P. Holstege
- 92) **Elderly Man with Diffuse Facial Edema.** Case: Alexander B. Baer
- 93) **Acute-onset Double Vision.** Case: Chris S. Bergstrom
- 94) **Low Back Pain in a Car Accident Victim.** Case: Alexander B. Baer; Figure 1: Alexander B. Baer
- 95) **Pain and Rash following Contact with a Caterpillar.** Case 1: Christopher P. Holstege; Case 2: Sue O. Kell; Figure 1: Christopher P. Holstege
- 96) **Moonshine-induced Basal Ganglion Necrosis and metabolic acidosis.** Case: Christopher P. Holstege; Figure 1: Christopher P. Holstege
- 97) **Rock Climber with Finger Pain, Swelling and Redness.** Case: Joseph D. Forrester
- 98) **Vomiting and Syncope Following Ingestion of Ramps.** Case: Christopher P. Holstege; Figure 1: Christopher P. Holstege
- 99) **Chest Pain and Subtle ST Segment Elevation.** Case: William J. Brady
- 100) **Herbalist with Bradycardia and Vision Changes.** Case: Christopher P. Holstege
- 101) **Painless Penile Ulcer.** Case: William D. James
- 102) **Hyperthermia, Autonomic Instability, and Confusion in a Traveler.** Case: Christopher P. Holstege; Figure 1: Christopher P. Holstege; Figure 2: Christopher P. Holstege
- 103) **Immigrant with Neck Swelling.** Case: William H. Shoff; Figure 1: Suzanne M. Shepherd
- 104) **Eyelid Laceration following a Brawl.** Case: Chris S. Bergstrom
- 105) **Young Athlete with Back Pain.** Case: Christopher P. Holstege; Figure 1: Christopher P. Holstege
- 106) **Chest Pain and Hypotension in an Adult Male patient.** Case: William J Brady; Figure 1: William J Brady
- 107) **Adult Male with Atraumatic Lower Back Pain and Leg Weakness.** Case: Alexander B. Baer; Figure 1: Alexander B. Baer
- 108) **Facial Swelling in a Patient with Poor Dentition.** Case: Alexander B. Baer
- 109) **Weakness and Bradycardia in an Elderly Female Patient.** Case: William J. Brady
- 110) **Lightning Strike-induced Skin Changes.** Case: Christopher P. Holstege; Figure 1: Christopher P. Holstege; Figure 2: Christopher P. Holstege

Part I

Case Presentations and Questions

CASE 1 | Slash Wound to the Neck

Kevin S. Barlotta, MD and Alexander B. Baer, MD

Case presentation: A 35-year-old female presents to the emergency department after an altercation. She states that she was attacked with a hunting knife. She complains of pain only at the wound site. She denies voice changes or difficulty swallowing. Her injury is depicted in the illustration.

Question: What zone of injury is represented in the image?

- A. Zone I
- B. Zone II
- C. Zone III
- D. Zone IV
- E. Zone V



See page 77 for Answer, Diagnosis, and Discussion.

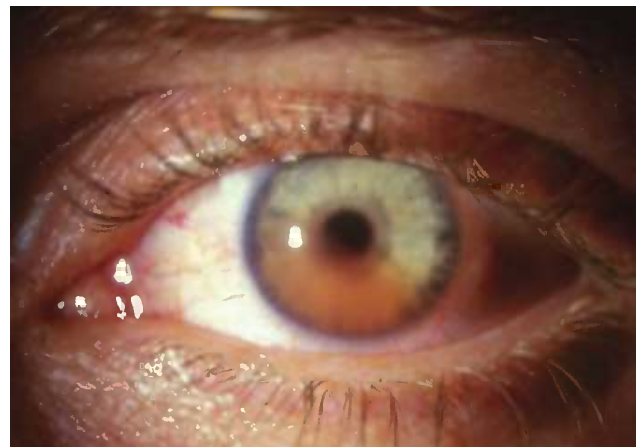
CASE 2 | “I’ve Got Blood in My Eye”

Chris S. Bergstrom, MD and Alexander B. Baer, MD

Case presentation: A 22-year-old Caucasian male is evaluated in the emergency department with a complaint of marked left eye pain and blurred vision after being struck in the eye with a lead fishing weight. On physical examination, his visual acuity is 20/60 in the left eye. Pupillary examination is normal. Slit-lamp examination shows a clear cornea. The anterior chamber is deep, with suspended red blood cells in the aqueous humor, as pictured here. The iris detail is slightly obscured but otherwise normal with a central, round pupil.

Question: What is the next best step in this patient’s management?

- A. Administration of oral aspirin
- B. Infusion of intravenous heparin
- C. Emergent lateral canthotomy
- D. Administration of oral lisinopril
- E. Administration of atropine 1% ophthalmic drops



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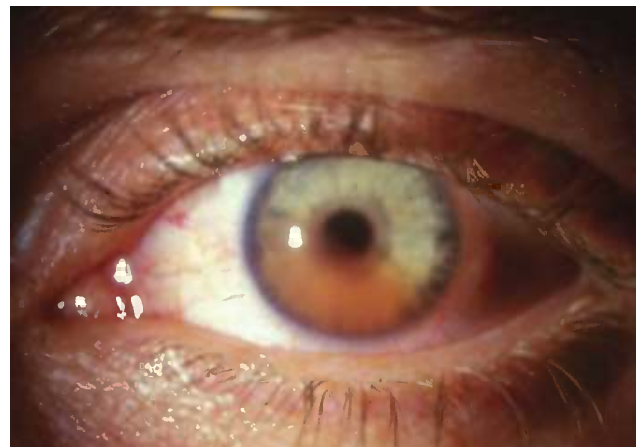
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CASE 3 | Forearm Fracture After Falling

Alexander B. Baer, MD

Case presentation: A 20-year-old male fell on an outstretched upper extremity while snowboarding. He presents with obvious arm deformity. Radiographs of the elbow were obtained.

Question: What is the name of the fracture pictured in the radiographs?

- A. Boxer's fracture
- B. Tear drop fracture
- C. Tillaux fracture



- D. Galeazzi fracture
- E. Monteggia fracture

See page 79 for Answer, Diagnosis, and Discussion.



CASE 4 | A Neonate with Fever and Rash

David L. Eldridge, MD

Case presentation: A 10-day-old male is brought to the emergency department by his mother. He has not eaten well for the past 24 hours and has reportedly been "very sleepy." Yesterday he began to develop a rash that now appears red at the base and is progressively "blistering" with clear fluid on his legs and face (pictured). Tonight he has had two episodes of uncontrollable shaking movements of his arms and legs, each lasting for a "few minutes." He was born 3 weeks prematurely, and his mother claims

no problems or issues with the pregnancy. He is afebrile but appears lethargic on physical examination.

Question: Which of the following tests would be *least helpful* in the clinical management of this patient given the likely diagnosis in this case?

- A. Serologic testing
- B. Viral cultures of the conjunctivae, rectum, and nasopharynx

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- B. Viral cultures of the conjunctivae, rectum, and nasopharynx



- C. Polymerase chain reaction testing of cerebrospinal fluid
- D. Liver transaminase levels

- E. Viral cultures of the skin lesions

See page 80 for Answer, Diagnosis, and Discussion.

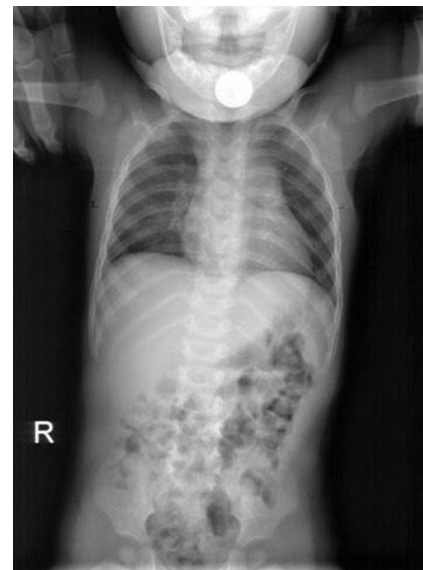
CASE 5 | A Missing Button Battery

Brendan G. Carr, MD and Sarah E. Winters, MD, MSCE

Case presentation: A 2-year-old boy presents to the emergency department with a complaint of food intolerance of abrupt onset. His mom reports that he was seen playing with a small calculator just before lunch. She has subsequently noticed that the calculator is missing its back, and she is concerned that he has swallowed the battery. On examination, he is in no apparent distress and is tolerating his secretions. His vital signs are normal. An X-ray is obtained and is noted here.

Question: What is the next most appropriate management strategy at this time?

- A. Discharge home and follow with serial outpatient abdominal X-rays
- B. Administer 25g activated charcoal orally
- C. Admit the patient for intravenous hydration, serial abdominal X-rays, and stool checks to confirm passage
- D. Infuse 1 mg glucagon intravenous to decrease lower esophageal sphincter pressure and monitor over the following 6 hours
- E. Emergent gastroenterology consultation for endoscopic removal of foreign body



See page 80 for Answer, Diagnosis, and Discussion.



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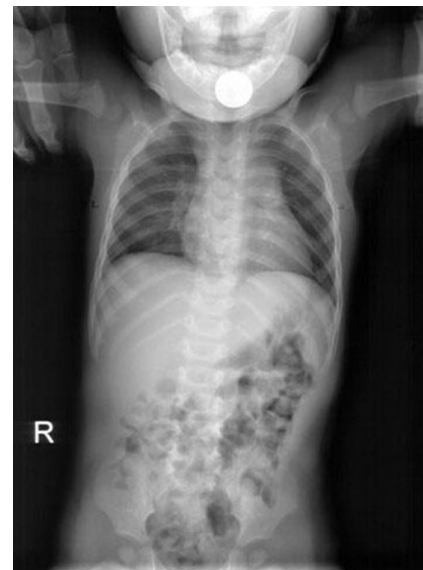
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See page 80 for Answer, Diagnosis, and Discussion.

CASE 6 | Anorexia, Hair Loss, and Fingernail Bands

Christopher P. Holstege, MD

Case presentation: A 62-year-old man has been hospitalized 10 times during the previous 5 years. He has been treated for gastrointestinal disturbances, cardiomyopathy, leucopenia, and paresthesias. He presents again after several days of uncontrollable diarrhea and vomiting. His “glove and sock” paresthesias have rapidly progressed. He is having significant hair loss and is experiencing weakness of the upper and lower extremities. A picture of his nails is noted below.

Question: What substance is most likely responsible for his signs and symptoms?

- A. Arsenic
- B. Barium
- C. Aluminum
- D. Chromium
- E. Bismuth

See page 82 for Answer, Diagnosis, and Discussion.



CASE 7 | Wide Complex Tachycardia in a Young Adult

William J. Brady, MD

Case presentation: A 24-year-old female patient with no medical history of significance, transported to the emergency department via paramedics, had been complaining of sudden weakness and palpitations. All her symptoms had resolved prior to the paramedics' arrival at the scene. In the emergency department, the patient noted a recurrence of her symptoms; examination at that time demonstrated an alert patient with minimal distress. The vital signs were: blood pressure 100/70 mmHg, pulse 240 beats/minute, and respiration 38 per minute. The monitor revealed a rapid, wide complex rhythm (pictured).

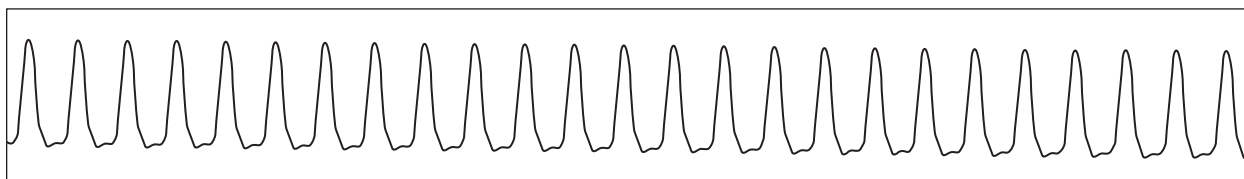
The patient received amiodarone intravenously. During the infusion, she became lethargic with a sudden reduction in blood pressure. Immediate electrical cardioversion

was undertaken with a return of a normal mental status and the second ECG noted here. The remainder of the examination normalized as well.

Question: Of the listed interventions, the most appropriate initial intervention is:

- A. Intravenous diltiazem
- B. Oral metoprolol
- C. Intravenous procainamide
- D. Oral amiodarone
- E. Intravenous potassium

See page 83 for Answer, Diagnosis, and Discussion.



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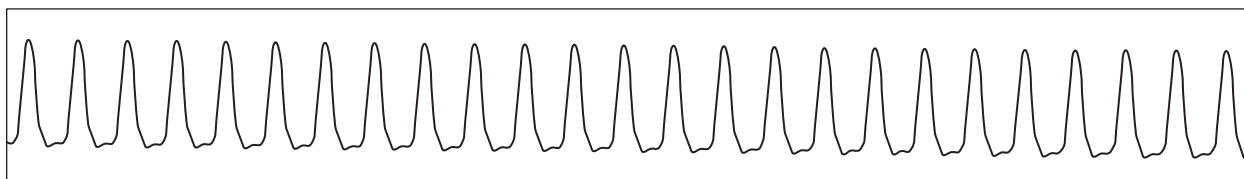
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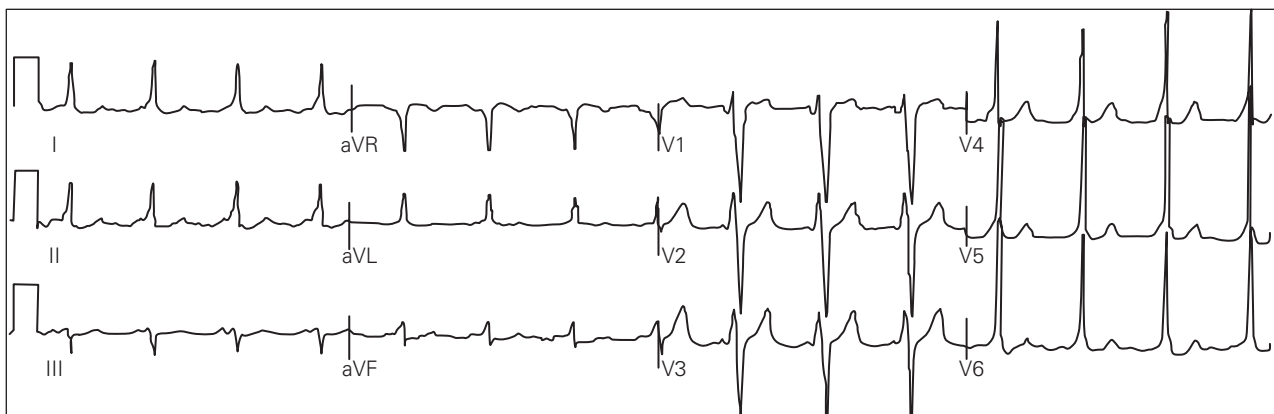
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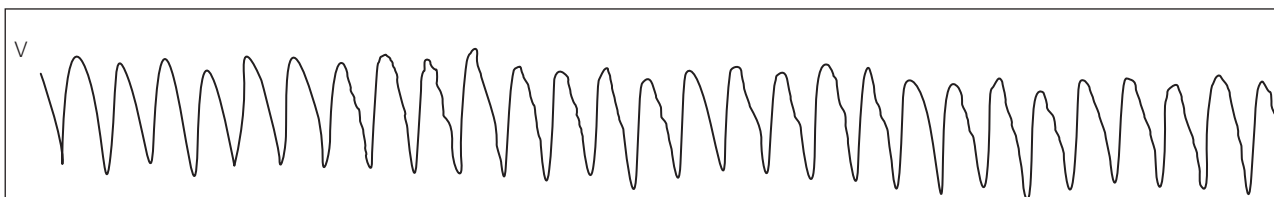
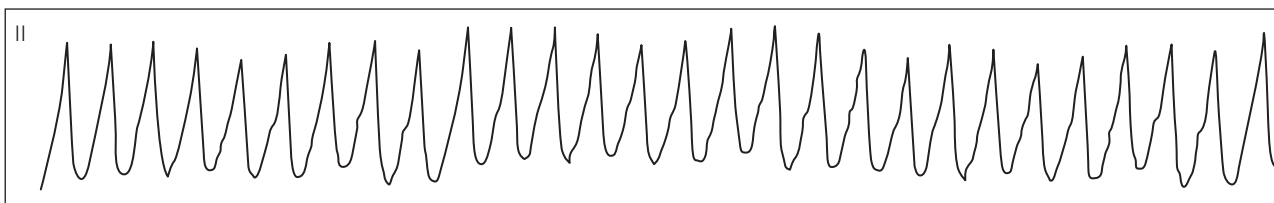


CASE 8 | Wide Complex Tachycardia in an Older Male Patient

William J. Brady, MD

Case presentation: A 57-year-old male with a history of angina and coronary artery disease experienced a sudden syncopal event. The patient regained consciousness minutes later and noted only palpitations and weakness. He was transported to the emergency department via a private vehicle. On arrival, he was pale and diaphoretic

with a blood pressure of 80mmHg by palpation and a pulse of 190 beats per minute. The cardiac monitor demonstrated a wide complex tachycardia, as shown here, in leads II and V. The patient was sedated and cardioverted, with the return of sinus rhythm and an adequate blood pressure.

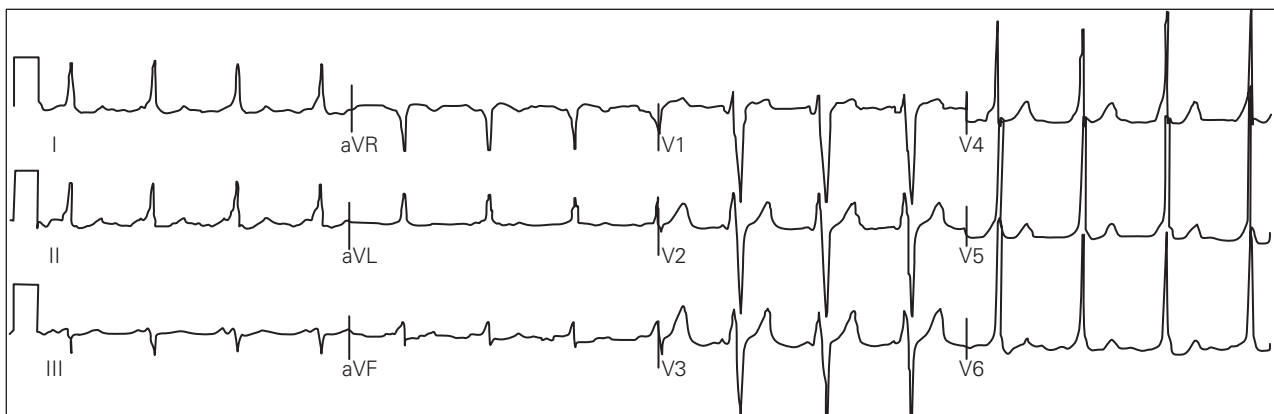


Question: In the setting of a wide complex tachycardia, select the correct statement:

- A. Urgent therapy is dependent upon a precise rhythm diagnosis
- B. Ventricular tachycardia and supraventricular tachycardia with aberrant conduction are easily distinguished
- C. Certain electrocardiographic features suggest the diagnosis of ventricular tachycardia

- D. Patient age is an absolute indicator of rhythm diagnosis in a wide complex tachycardia
- E. Wide complex tachycardia due to drugs is easily distinguished from other causes

See page 84 for Answer, Diagnosis, and Discussion.

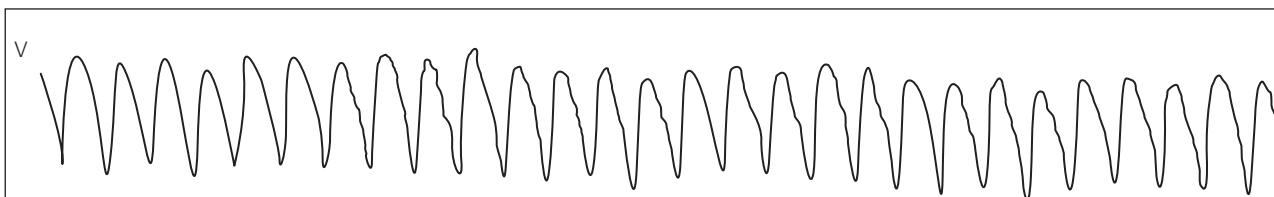
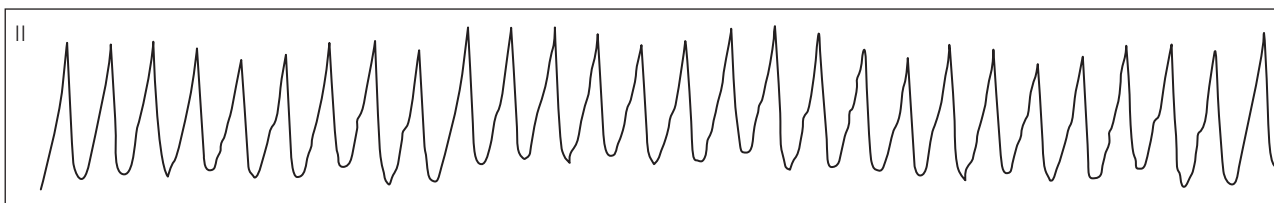


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- D. Patient age is an absolute indicator of rhythm diagnosis in a wide complex tachycardia
- E. Wide complex tachycardia due to drugs is easily distinguished from other causes

See page 84 for Answer, Diagnosis, and Discussion.

CASE 9 | Muscle Spasms Following a Spider Bite

J. Michael Kowalski, DO and Adam K. Rowden, DO

Case presentation: A 25-year-old female presents to the emergency department with severe back and abdominal pain. She also complains of nausea and chest tightness. She reports a “pinprick” sensation to the sole of her right foot while putting her shoes on about 20 minutes prior to her arrival. Upon inspection of her right shoe, she discovered the creature pictured here. Over the next 60 minutes, her pain first intensified in her right leg and then moved into her groin and into her back. She took ibuprofen without relief. Her physical examination is significant for a red target lesion approximately 1 cm in circumference on the plantar aspect of her right foot, hypertension (180/100 mmHg), tachycardia (145 beats per minute), and marked spasm of her lumbar and thoracic paraspinal muscles.

Question: Which of the following is an indication for the administration of antivenin?

- A. Presence of erythema at the suspected site of skin penetration
- B. Immediately upon correct identification of the offending creature



- C. Clinical improvement in the patient's condition following the administration of intravenous opioids and benzodiazepines
- D. Pain and muscle spasms that progress proximally from the extremity to the trunk
- E. Uterine contractions in a pregnant female

See page 86 for Answer, Diagnosis, and Discussion.

CASE 10 | Necrotic Skin Lesion

David A. Kasper, DO, MBA, Aradhna Saxena, MD, and Kenneth A. Katz, MD

Case presentation: A 57-year-old man complains of an expanding “spider bite” on his left pretibial area. He had noticed the lesion 3 days previously as a painful and progressively enlarging “pimple.” His medical history is notable for ulcerative colitis, treated with mesalamine. On physical examination, an ulcer with a rolled, violaceous border and a central black eschar is present on the left pretibial area (see illustration). There is no lower extremity edema. The patient is otherwise well.

Question: What is the most appropriate management strategy at this time?

- A. Empiric treatment with broad-spectrum antibiotics
- B. Debridement of the eschar
- C. Consultation of dermatology for biopsy of the ulcer for tissue culture and histology
- D. Treatment with compression stockings
- E. Infusion of brown recluse spider antivenom



See page 87 for Answer, Diagnosis, and Discussion.

CASE 9 | Muscle Spasms Following a Spider Bite

J. Michael Kowalski, DO and Adam K. Rowden, DO

Case presentation: A 25-year-old female presents to the emergency department with severe back and abdominal pain. She also complains of nausea and chest tightness. She reports a “pinprick” sensation to the sole of her right foot while putting her shoes on about 20 minutes prior to her arrival. Upon inspection of her right shoe, she discovered the creature pictured here. Over the next 60 minutes, her pain first intensified in her right leg and then moved into her groin and into her back. She took ibuprofen without relief. Her physical examination is significant for a red target lesion approximately 1 cm in circumference on the plantar aspect of her right foot, hypertension (180/100 mmHg), tachycardia (145 beats per minute), and marked spasm of her lumbar and thoracic paraspinal muscles.

Question: Which of the following is an indication for the administration of antivenin?

- A. Presence of erythema at the suspected site of skin penetration
- B. Immediately upon correct identification of the offending creature



- C. Clinical improvement in the patient's condition following the administration of intravenous opioids and benzodiazepines
- D. Pain and muscle spasms that progress proximally from the extremity to the trunk
- E. Uterine contractions in a pregnant female

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See page 87 for Answer, Diagnosis, and Discussion.

CASE 11 | Intense Pain Following High-pressure Injection Injury

David T. Lawrence, DO

Case presentation: A 30-year-old automobile technician presents to the emergency department with a complaint of pain and swelling in the dorsum of his left hand near the metacarpophalangeal (MCP) joint of his index finger after injury with a grease injector. On examination, there is slight swelling of the dorsum of the hand and a small pinpoint puncture wound just proximal to the MCP joint of the index finger as noted in the picture. There is pain with passive movement and good capillary refill of the index finger and thumb, and no neurologic deficits distal to the injury are appreciated.



Question: What is the most appropriate management?

- A. Check tetanus status, prescribe analgesics, and discharge home
- B. Prescribe antibiotics and analgesics, check tetanus status, and discharge home
- C. Obtain an X-ray, check tetanus status, immobilize with a splint, and discharge home with a prescription for antibiotics and analgesics and instructions to follow-up with an orthopedist in 3–5 days
- D. Provide parenteral analgesia, obtain an X-ray, check tetanus status, arrange an immediate surgical

consultation for exploration and decompression debridement, and provide prophylactic antibiotics

- E. Insert a 14-gauge angiocatheter and aspirate the injected material

See page 88 for Answer, Diagnosis, and Discussion.

CASE 12 | Prenatal Vitamin Overdose

Christopher P. Holstege, MD and Adriana I. Goldberg, MD

Case presentation: A 16-year-old female intentionally overdosed on an unknown quantity of “vitamins.” She arrives at the emergency department 4 hours after the overdose complaining of nausea, vomiting, and epigastric abdominal pain. Her initial vital signs reveal pulse 123 beats per minute, blood pressure 85/34 mmHg, respiration 24 breaths per minute, and temperature 37.2°C. Her examination is significant only for epigastric tenderness on palpation of her abdomen. Her laboratory studies

are significant for the following: iron 567 mg/dL, serum bicarbonate 15 mEq/L, glucose 256 mg/dL, and white blood count $13.2 \times 10^9/L$. A radiograph of her abdomen is pictured here.

Question: Which of the following is the next most appropriate management step for this patient?

- A. Begin an intravenous infusion of deferoxamine
- B. Administer dimercaprol (BAL) intramuscular

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Question: Which of the following is the next most appropriate management step for this patient?

- A. Begin an intravenous infusion of deferoxamine
- B. Administer dimercaprol (BAL) intramuscular

- C. Infuse calcium disodium ethylenediaminetetraacetate (EDTA)
- D. Administer succimer (DMSA) orally
- E. Administer D-penicillamine orally

See page 89 for Answer, Diagnosis, and Discussion.



CASE 13 | Blurred Vision Following Yard Work

Allyson Kreshak, MD

Case presentation: A 66-year-old male presents with a chief complaint of blurry vision. He had been outside cleaning his yard in Central Virginia prior to developing the symptoms. He denies headache, nausea or vomiting, and has no other neurologic complaints. He also denies a history of trauma. He is otherwise healthy. His vital signs are as follows: heart rate 88 beats per minute, blood pressure 142/76 mmHg, oral temperature 37.1°C, respiration 16 breaths per minute, pulse oximetry 99% on room air. His examination is remarkable for only the finding noted in the photograph.

Question: Which of the following is a likely cause of this patient's condition?

- A. Stroke
- B. Tentorial herniation
- C. Cataracts
- D. Tonic pupil
- E. Jimson weed exposure (*Datura stramonium*)

See page 90 for Answer, Diagnosis, and Discussion.



- C. Infuse calcium disodium ethylenediaminetetraacetate (EDTA)
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See page 90 for Answer, Diagnosis, and Discussion.



CASE 14 | Foot Pain in a Gymnast

Hoi K. Lee, MD

Case presentation: A 19-year-old female gymnast presents with worsening pain in her right foot that has developed over the previous 3 days. The pain is located over the lateral aspect of her foot. Physical examination reveals mild tenderness with palpation over the fifth metatarsal and associated swelling in the area. The patient is able to ambulate with a slight limp. Her foot radiographs are shown here.

Question: Which of the following is true regarding this injury?

- A. A computed tomography scan should be obtained to rule out possible metatarsophalangeal joint involvement
- B. Nonunion due to lack of vascular supply is a common complication of this fracture
- C. Treatment includes application of a short-leg walking cast for up to 4–6 weeks, and outpatient follow-up with an orthopedist
- D. Emergent orthopedic consultation is required for this type of injury
- E. Hematoma block with fracture reduction should be performed



See page 91 for Answer, Diagnosis, and Discussion.

CASE 15 | A Child with Bruises of Different Ages

David L. Eldridge, MD

Case presentation: The 3-year-old male pictured here has been brought in by his parents because of altered



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See page 91 for Answer, Diagnosis, and Discussion.

CASE 15 | A Child with Bruises of Different Ages

David L. Eldridge, MD

Case presentation: The 3-year-old male pictured here has been brought in by his parents because of altered



mental status following a fall. His parents report that about an hour ago he tripped on some of his own toys and fell down the stairs at home. He did not lose consciousness but he has been “very sleepy” since. On examination, he is lethargic but arousable and obeys commands. He also has gross deformity, point tenderness, and erythema at the middle anterior aspect of his right humerus. In addition, he has facial contusions and back contusions as illustrated that appear to be of varying ages.

Question: Which of the following bruising patterns is *least concerning* for child abuse?

A. Bruising on the right knee of a 2-month-old infant

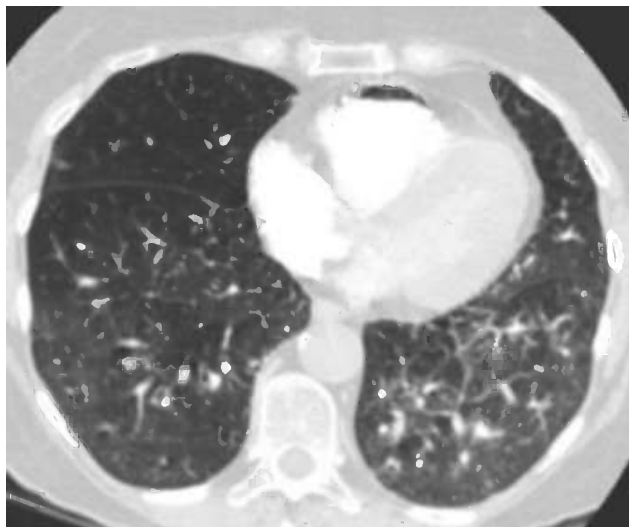
- B. Multiple bruises on the knees and shins of a 3-year-old female
- C. A 5-year-old male with multiple bruises on his cheeks and forehead
- D. A 2-year-old female with bruising along the arms that appears to have a consistent loop pattern
- E. Multiple bruises along the buttocks of a 2-year-old male

See page 91 for Answer, Diagnosis, and Discussion.

CASE 16 | Sudden Shortness of Breath after Removal of a Central Line

Christopher P. Holstege, MD

Case presentation: A 66-year-old woman had a right internal jugular central venous line removed. Following removal of the central line, the patient developed acute dyspnea, and her oxygen saturation dropped to 70% at room air. The patient was given 10L oxygen via a non-rebreather and placed in the Trendelenburg position with a left lateral decubitus tilt. Lung examination was clear. An initial chest radiograph revealed no abnormalities. Further evaluation was performed via computed tomography scan (illustrated).



Question: Which of the following is the next most appropriate management?

- A. Heparin
- B. Coumadin
- C. Hyperbaric oxygen
- D. Thrombolytics
- E. Nitroglycerin

See page 92 for Answer, Diagnosis, and Discussion.

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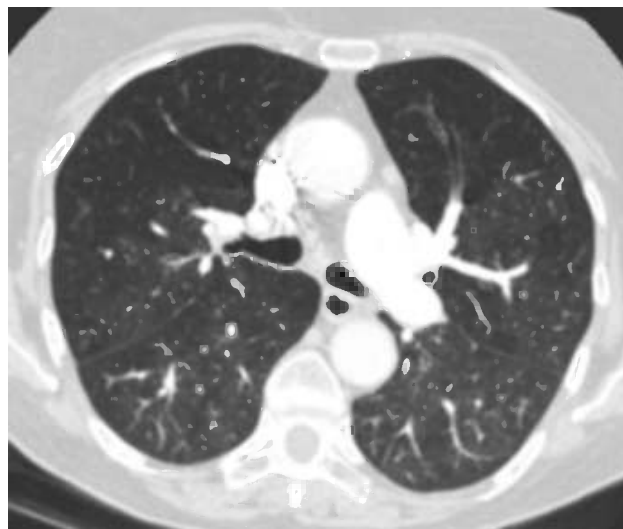
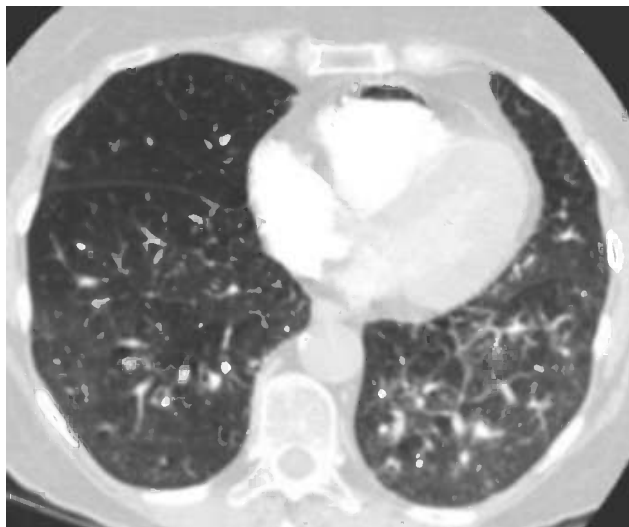
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CASE 17 | “My Eyes Are Yellow!”

David T. Lawrence, DO

Case presentation: A 48-year-old female presents to the emergency department with the chief complaint: “My eyes are yellow!” She denies other clinical symptoms. Her physical examination is remarkable only for scleral icterus and jaundice (illustrated). No abdominal tenderness or hepatomegaly is detected.



Question: Which of the following statements is true?

- A. Her scleral icterus effectively rules out hemolysis as a cause of her condition
- B. Normal to mildly elevated transaminases with an elevated alkaline phosphatase and conjugated bilirubin would suggest extrinsic bile duct compression in this patient
- C. The presence of Courviosier’s sign suggests an infectious etiology in this patient
- D. The lack of abdominal pain effectively rules out pancreatic cancer as a cause of her condition
- E. Excessive beta-carotene ingestion is a potential cause of this patient’s condition

See page 93 for Answer, Diagnosis, and Discussion.

CASE 18 | Pleuritic Chest Pain in a Young Adult Male

William J. Brady, MD

Case presentation: A 32-year-old male without a medical history presented via ambulance to the emergency department with chest pain. The pain was left-sided in location and worsened upon both inspiration and reclining. The examination revealed a young patient in moderate distress due to chest pain. A rhythm strip and a 12-lead ECG are noted in the figure. Laboratory studies were normal, and a chest radiograph revealed a normal heart size and lung fields. The patient received intravenous morphine sulfate and ketorolac, which reduced the pain.

Question: The ECG in a patient with the disease represented in this case can show all of the following except:

- A. Diffuse ST segment elevation
- B. Electrical alternans
- C. PR segment changes
- D. Prominent Q waves
- E. T wave inversion

See page 94 for Answer, Diagnosis, and Discussion.

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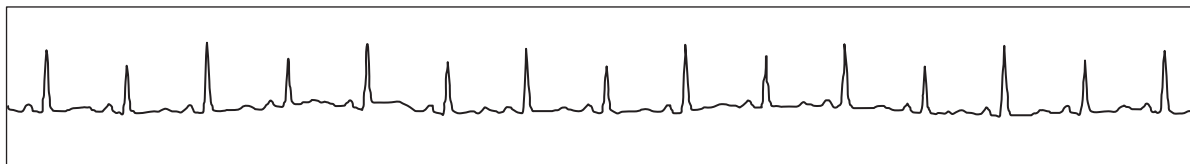
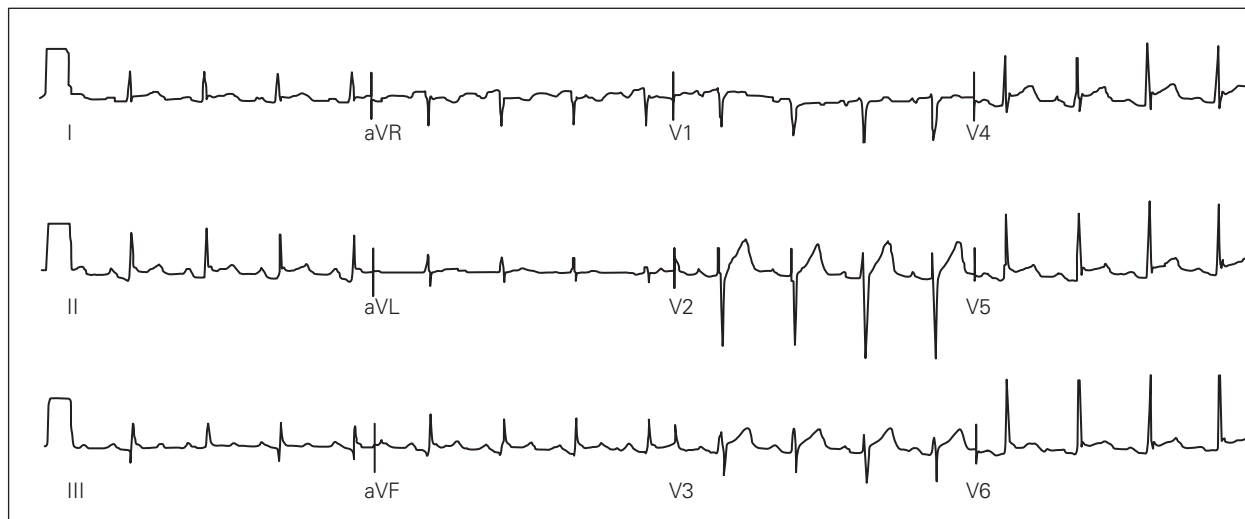
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A**B**

CASE 19 | Exposed During a Blizzard

Joseph D. Forrester, MD and Christopher P. Holstege, MD

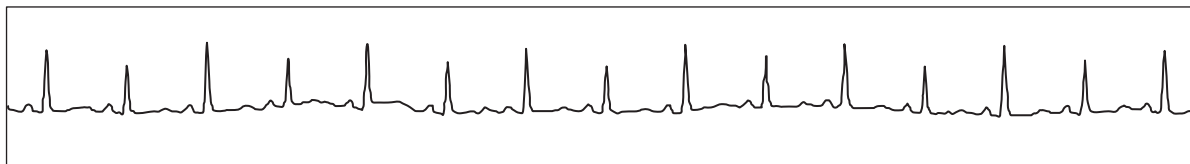
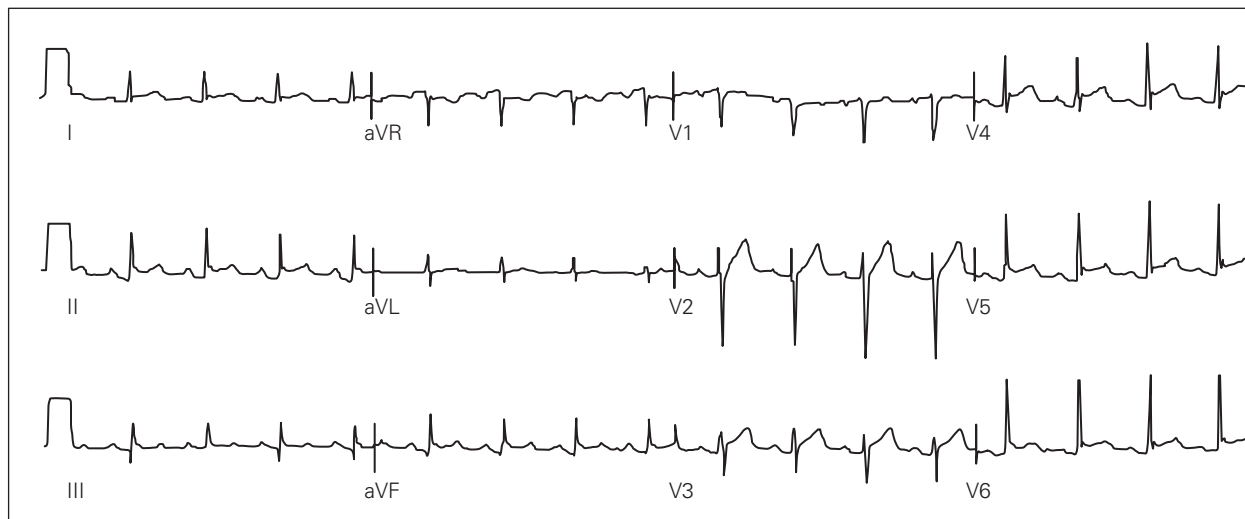
Case presentation: A 38-year-old male presents to the emergency department after being lost in the wilderness during a blizzard. His feet and legs are ice cold with poor pulses and are shown in the figure. He is complaining of marked pain and numbness of his lower extremities. His vital signs are normal, including a core body temperature of 37.1°C.

Question: Which of the following is the most appropriate initial management?

- A. Gradual rewarming with infrared warming lights
- B. Rapid rewarming of the afflicted extremities in a warm water (40–42°C) bath for 30 minutes
- C. Urgent surgical consultation for early debridement and fasciotomy
- D. Vigorous massage in addition to rewarming
- E. Heparin therapy and administration of warm intravenous fluids

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A**B**

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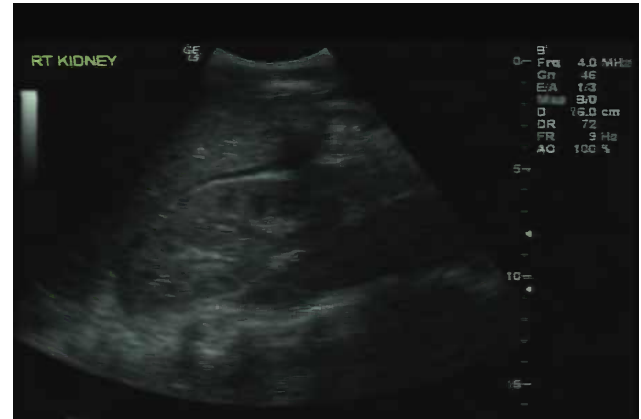
See page 95 for Answer, Diagnosis, and Discussion.



CASE 20 | FAST Evaluation of a Trauma Patient

John S. Rajkumar, MD and James H. Moak, MD, RDMS

Case presentation: A 25-year-old unrestrained driver presents to the emergency department after a motor vehicle crash. En route to the hospital, he has received 1 L intravenous lactated Ringer's solution. He arrives with the following vital signs: blood pressure 90/70 mmHg, pulse 120 beats per minute, respiration 22 breaths per minute, and oxygen saturation 100%. He has a Glasgow Coma Scale score of 15, facial contusions, and lacerations, with "tingling" in his hands bilaterally. He complains of pain "everywhere." Neurologic examination reveals decreased sensation in both hands. A focused assessment with sonography in trauma (FAST) is performed; a still image of the right upper quadrant of his abdomen is shown in the figure.



Question: Which of the following describes the patient's condition and the next most appropriate action in his management?

- A. The ultrasound shows no significant abnormality. If the rest of the FAST scan is negative, the patient should be transfused with whole blood, and, once stabilized, cervical cord trauma will be his most urgent issue. His neck should be immobilized and evaluated by a neurosurgeon
- B. The ultrasound image suggests there is less than 200 mL free fluid. The patient should be transfused with whole blood, sent for computed tomography (CT) scanning for evaluation of the abdomen, and observed with serial abdominal examinations
- C. The ultrasound image suggests over 200 mL free fluid. The patient should be transfused with whole blood, sent to CT for evaluation of the abdomen, and observed with serial abdominal examinations
- D. The ultrasound suggests less than 200 mL free fluid. The patient should have immediate surgical evaluation in preparation for transfer to the operating room for exploratory laparotomy
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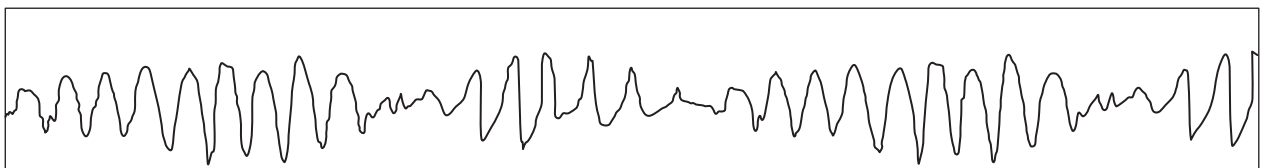
CASE 21 | Chest Pain with Sudden Cardiac Death

William J. Brady, MD

Case presentation: A 65-year-old man presented to the emergency department with chest pain and syncope. The examination demonstrated an alert man in mild distress with normal vital signs; diaphoresis was present on the examination. The patient suddenly slumped over, unre-

sponsive and without a pulse. The cardiac rhythm strip shown in the figure was obtained.

While attempts were made for electrical therapy, the rhythm changed spontaneously to sinus rhythm with a pulse. A 12-lead ECG was obtained and is also shown



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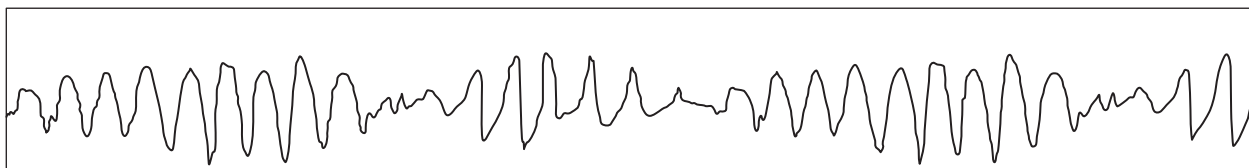
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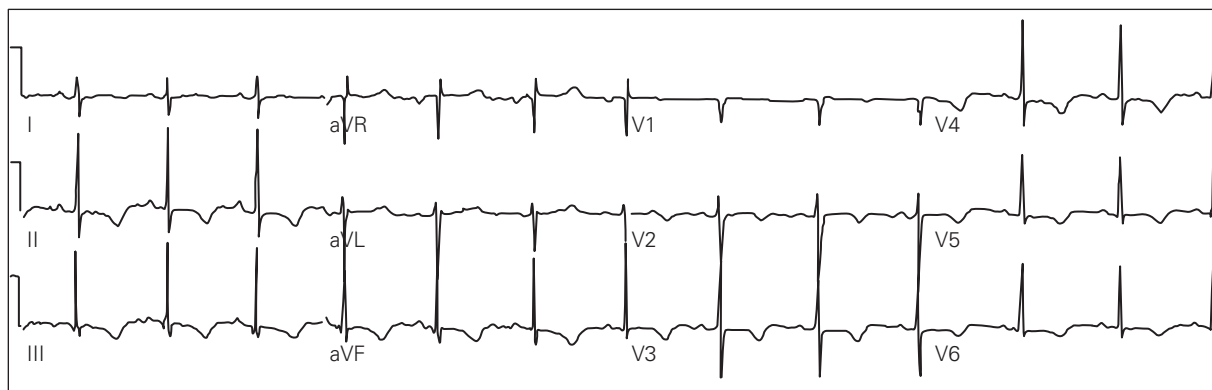
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While attempts were made for electrical therapy, the rhythm changed spontaneously to sinus rhythm with a pulse. A 12-lead ECG was obtained and is also shown





here. Additional diagnostic studies were performed while therapy was being initiated.

Question: Which of the following would be consistent with the rhythm strip and ECG noted in this case?

- A. Hypercalcemia
- B. Hyperchloremia

- C. Hypernatremia
- D. Hypomagnesemia
- E. Hypophosphatemia

See page 97 for Answer, Diagnosis, and Discussion.

CASE 22 | Wrist “Sprain” in a Child

Jennifer S. Boyle, PharmD, MD

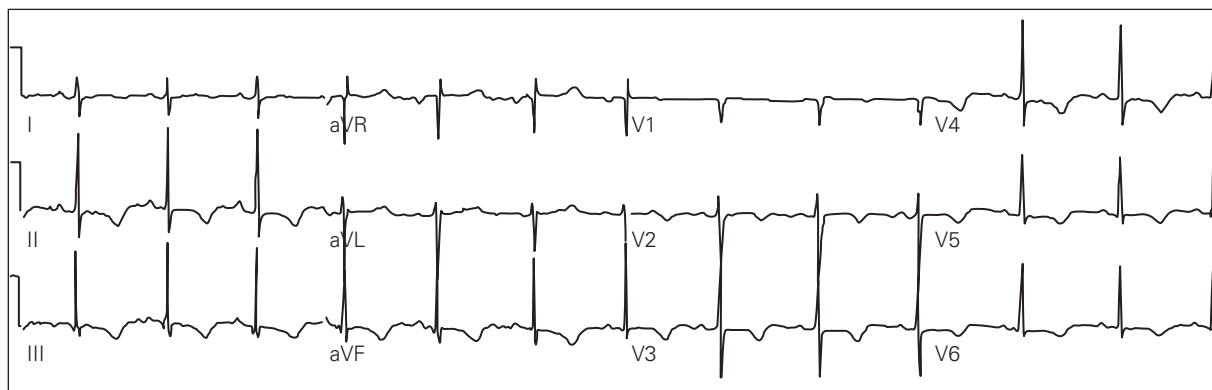
Case presentation: An 8-year-old boy presents to the emergency department after having fallen onto his left arm (while outstretched) 2 days previously. He complains of wrist pain that worsens with movement. On examination, the child is holding a painful, minimally swollen left wrist. His motor, sensory, and vascular examination is normal, but he does have mild tenderness to palpation over his left lateral wrist. An X-ray is obtained, and is displayed in the figure.

Question: Which management strategy is the most appropriate for this patient?

- A. Discharge home with no outpatient follow-up necessary
- B. Hematoma block with closed reduction
- C. Hospital admission with traction
- D. Emergent orthopedic surgical intervention
- E. Wrist immobilization and analgesic therapy

See page 98 for Answer, Diagnosis, and Discussion.





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- E. Wrist immobilization and analgesic therapy

See page 98 for Answer, Diagnosis, and Discussion.



CASE 23 | Acute Eye Pain and Blurred Vision in an Elderly Female

Chris S. Bergstrom, MD and Alexander Baer, MD

Case presentation: A 68 year-old-female with no significant past medical history presents to the emergency department complaining of pain, blurred vision, and colored halos around lights in her left eye. She states that her visual symptoms started acutely along with associated nausea, vomiting, and a frontal headache.

On physical examination, the visual acuity is 20/30 in the right eye and 20/100 in the left. Pupillary examination reveals a sluggish, mid-dilated pupil in the left eye as noted in the illustration. Slit-lamp examination of the right eye is unremarkable. Examination of the left eye shows conjunctival injection with a cloudy cornea. The anterior chamber is shallow, and the iris detail is blurred. Palpation of the globes through closed lids demonstrates a normal tension in the right eye and a firm, tense left eye. Intraocular pressures are measured and reveal 15mmHg in the right eye and 58mmHg in the left.

Question: Which of the following agents would be appropriate to administer to this patient?

- A. Subcutaneous epinephrine (adrenaline)
- B. Topical atropine
- C. Topical timolol
- D. Intravenous atropine
- E. Topical phenylephrine

See page 99 for Answer, Diagnosis, and Discussion.



CASE 24 | Heel Pain Following a Fall

Jennifer S. Boyle, PharmD, MD

Case presentation: A 26-year-old roofer fell off a 12-foot-high roof and landed on the pavement below. He was wearing steel-toed construction boots and landed directly on his left heel in a standing position. He felt extreme pain in his heel after the fall and was unable to ambulate at the scene. His co-workers called emergency medical services, and he was placed in spinal immobilization and transported to the emergency department. On arrival, he com-

plained of left heel pain and midline low back pain. His examination revealed a markedly swollen heel with ecchymosis and tenderness to palpation over the plantar surface of his hindfoot. Examination of his back revealed bilateral paraspinal muscle tenderness to palpation without midline bony tenderness. An intravenous line was placed, he was given morphine for pain control, and a foot radiograph series was significant for the finding pictured here.

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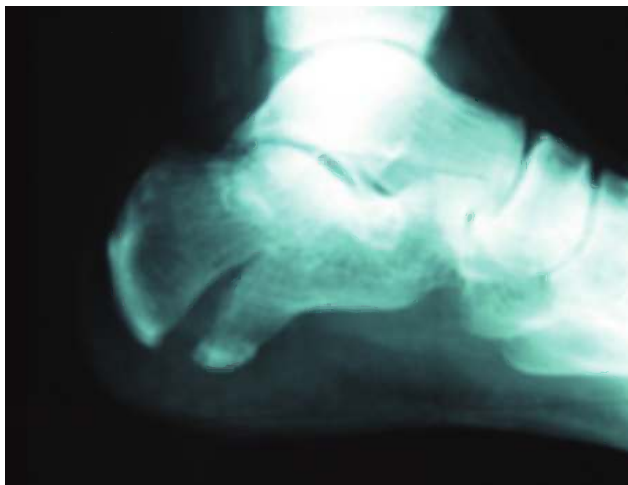


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Question: The next most appropriate step in the management of this man's injury is:

- A. Plaster cast immobilization, pain control, and orthopedic outpatient follow-up
- B. Radiographs of the lumbar spine to rule out accompanying fracture, with orthopedic consultation for possible operative intervention
- C. Crutches, nonweight-bearing, pain control, and follow-up with his family physician
- D. Posterior splint, nonweight-bearing, pain control, and orthopedic follow-up for a rigid cast in 3–5 days
- E. Fracture closed reduction and a posterior splint

See page 100 for Answer, Diagnosis, and Discussion.

CASE 25 | Confluent Rash on a Child

Sarah E. Winters, MD, MSCE and Brendan G. Carr, MD

Case presentation: A 2-year-old boy with no medical history presents to the emergency department with complaints of a diffuse rash over his bilateral lower extremities for the past 2 days that is now progressing to his trunk and upper extremities. He otherwise appears playful and well

with no complaint of itching or fever. His parents deny new detergents, creams, or drug exposures. They do, however, report mild upper respiratory symptoms 1 week ago. On physical examination, he has multiple confluent lesions with central clearing diffusely. The lesions are present on his palms and soles but are most prominent on his bilateral lower extremities. There is no conjunctival injection, and there are no sores in or around his mouth or genital area.



Question: What is the next most appropriate management strategy at this time?

- A. Obtain a complete blood count (CBC) and blood culture, administer ceftriaxone, and admit for observation
- B. Obtain a CBC and blood culture, but do not treat with antibiotics
- C. Discharge to home with diphenhydramine as needed for itching
- D. Consult dermatology emergently
- E. Administer subcutaneous epinephrine immediately

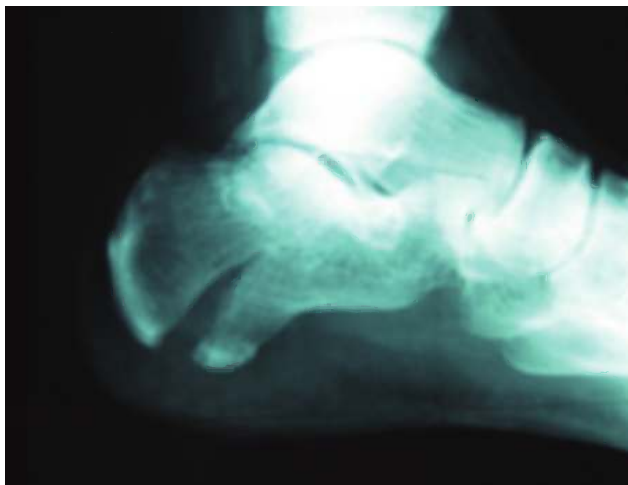
See page 101 for Answer, Diagnosis, and Discussion.

CASE 26 | Bradycardia Following an Herbal Ingestion

Alexander B. Baer, MD

Case presentation: A 23-year-old male native of Hong Kong presents with near syncope after a prodrome that

has included nausea, vomiting, paresthesias of the extremities, and dyspnea. His initial vital signs are: pulse



Question: The next most appropriate step in the management of this man's injury is:

- A. Plaster cast immobilization, pain control, and orthopedic outpatient follow-up
- B. Radiographs of the lumbar spine to rule out accompanying fracture, with orthopedic consultation for possible operative intervention
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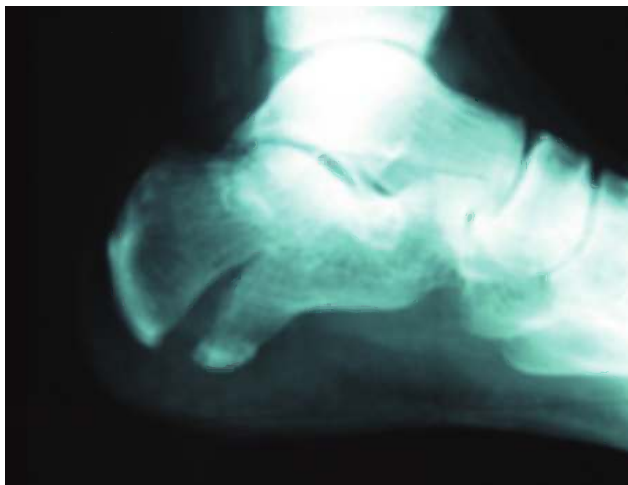
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Alexander B. Baer, MD

Case presentation: A 23-year-old male native of Hong Kong presents with near syncope after a prodrome that

has included nausea, vomiting, paresthesias of the extremities, and dyspnea. His initial vital signs are: pulse

32 beats per minute, blood pressure 75/32 mmHg, respiration 22 breaths per minute. The remainder of his physical examination is unremarkable. The family brings in an herbal product with a picture of this plant on the label.

Question: What would be the next most appropriate step in his management?

- A. Administer intravenous N-acetylcysteine
- B. Administer intravenous physostigmine
- C. Administer intravenous adenosine
- D. Administer intravenous diltiazem
- E. Administer intravenous atropine

See page 102 for Answer, Diagnosis, and Discussion.

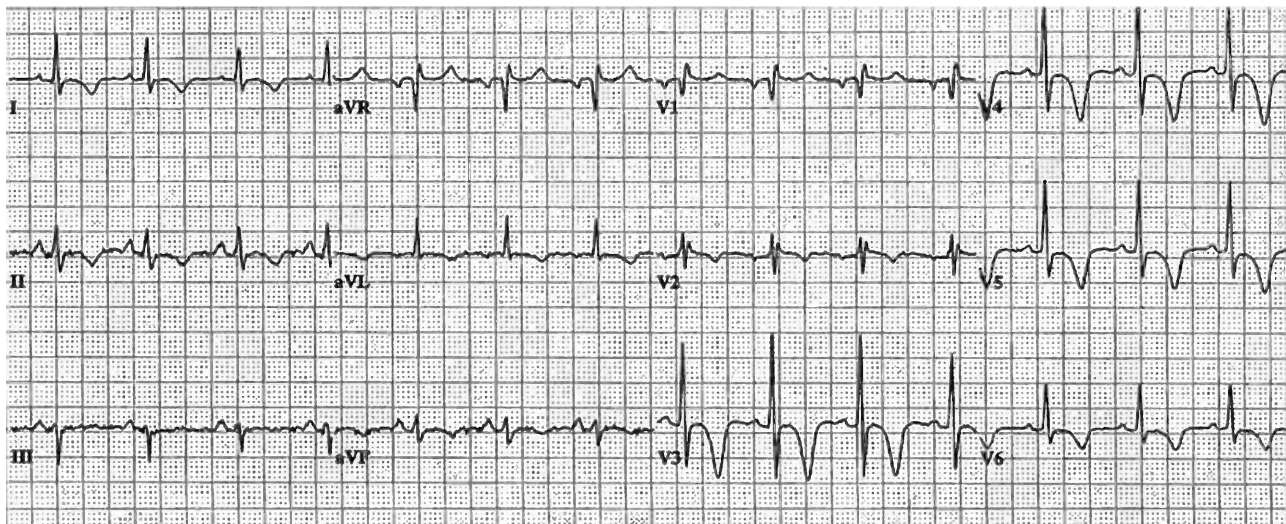


CASE 27 | A Pain-free Adult with Persistent T Wave Abnormalities

William J. Brady, MD

Case presentation: A 49-year-old male presented with a recent history of chest pain; the chest pain was associated with diaphoresis and nausea. The pain resolved

prior to arrival in the emergency department. The examination was unremarkable. The ECG rhythm strip seen here was obtained when the patient was sensation-free.



Question: In a patient with this clinical presentation, the next most appropriate diagnostic study is:

- A. Exercise stress test
- B. Exercise stress test with nuclear perfusion scan
- C. Stress echocardiography

- D. Cardiac catheterization
- E. Discharge

See page 102 for Answer, Diagnosis, and Discussion.

CASE 28 | Caustic Ingestion with Cardiotoxic Effects

Heather A. Borek, MD and Christopher P. Holstege, MD

Case presentation: A previously healthy 47-year-old male accidentally ingested a blue liquid he thought was a sport drink. He immediately noted throat irritation, and within 5 minutes of the ingestion he developed nausea and vomiting. He presented to the emergency department within 1 hour of the ingestion with a complaint of nausea, weakness, and intense pleuritic chest pain. His initial vital signs revealed: temperature 34.5°C, pulse 130 beats per minute, blood pressure 102/66 mmHg, and respiration 20 breaths per minute. His voice was hoarse, and he had difficulty swallowing his secretions. His examination was significant for an oropharynx with inflamed mucosa and an abdomen that was soft with mild tenderness diffusely.

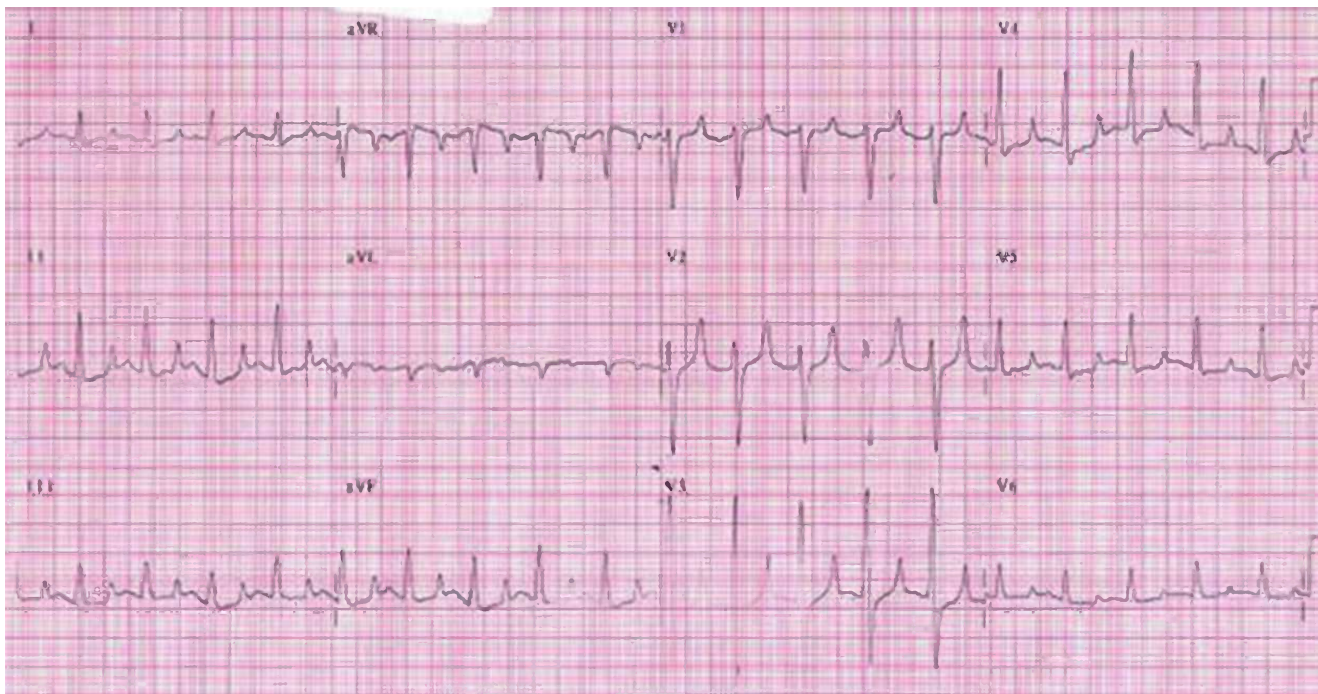
The patient's initial ECG (ECG 1) 1 hour after ingestion is shown here. His initial arterial blood gas revealed:

pH 7.28, P_{CO_2} 29 mmHg, P_{O_2} 209 mmHg, and HCO_3^- 13 mmol/L. Within one-half hour of his arrival, he became increasingly agitated, and his systolic blood pressure dropped to 80 mmHg. A repeat electrocardiogram (ECG 2) is noted below. Initial bedside evaluation of the ingested fluid by litmus paper revealed a pH less than 4.0.

Question: What electrolyte abnormality is most likely present on laboratory analysis?

- A. Hypermagnesemia
- B. Hypocalcemia
- C. Hypochloremia
- D. Hyponatremia
- E. Hypophosphatemia

See page 103 for Answer, Diagnosis, and Discussion.



ECG 1.

Question: In a patient with this clinical presentation, the next most appropriate diagnostic study is:

- A. Exercise stress test
- B. Exercise stress test with nuclear perfusion scan
- C. Stress echocardiography

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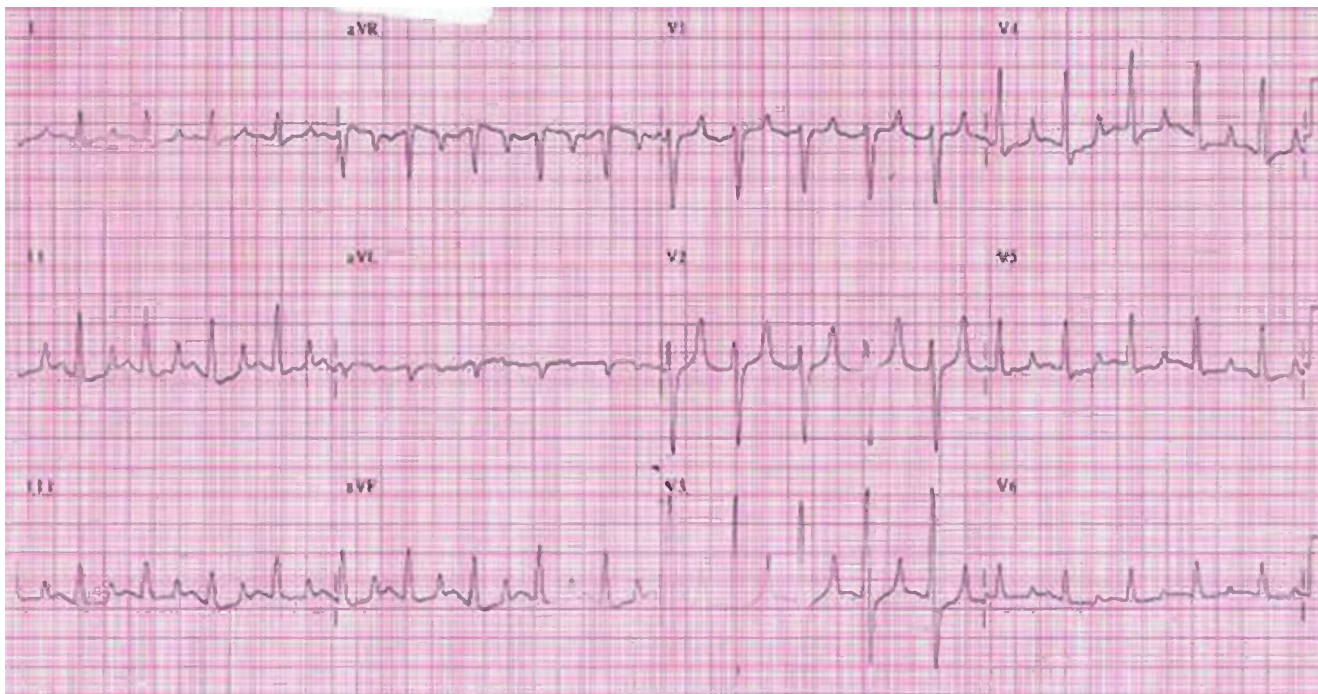
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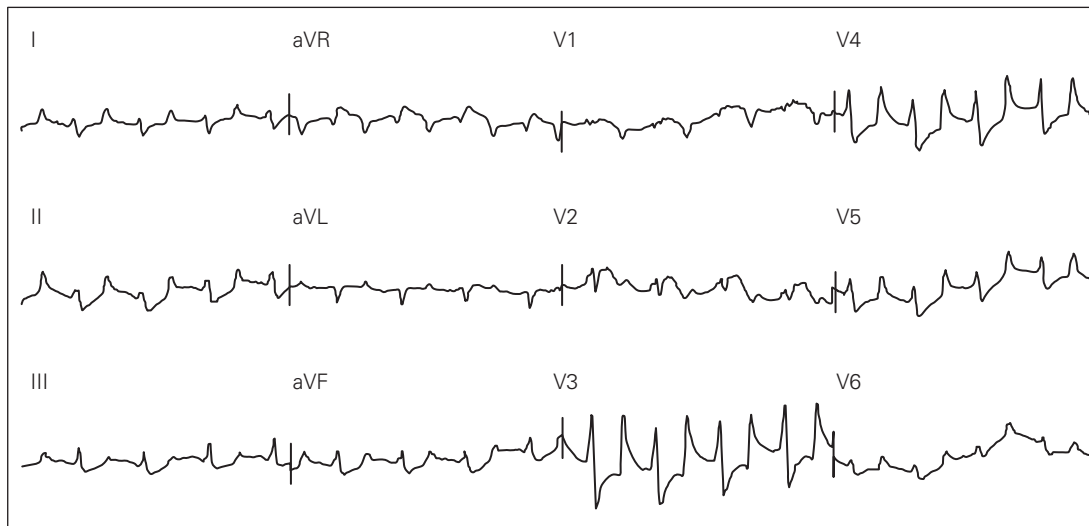
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ECG 1.



ECG 2.

CASE 29 | Chemical Eye Exposure

Chris S. Bergstrom, MD and Alexander B. Baer, MD

Case presentation: A 34-year-old female is seen in the emergency department after having an unknown chemical splashed in her face and eyes. She is complaining of burning, tearing, decreased vision, and light sensitivity. Gross inspection reveals first-degree burns to the periorbital skin and lids. The globes are intact.

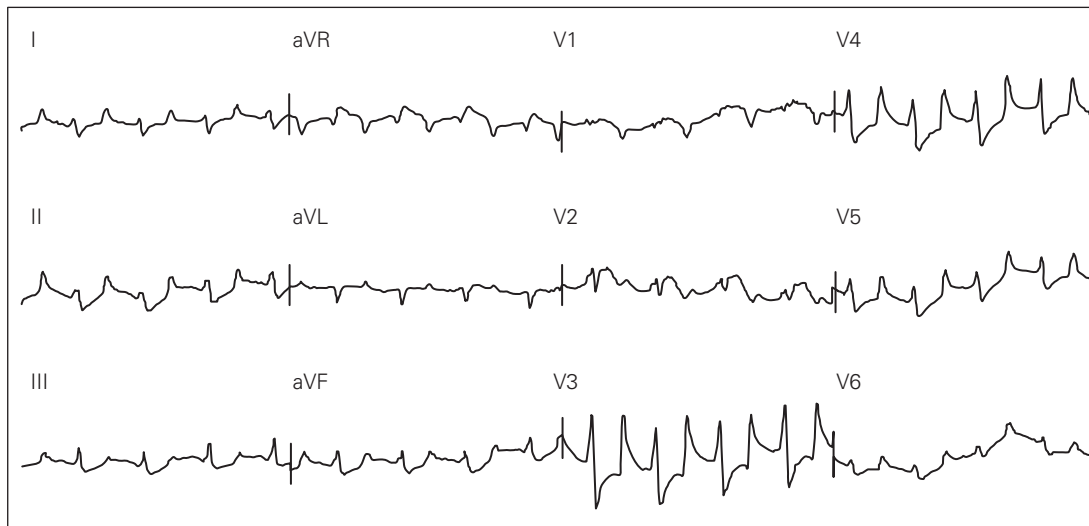
On physical examination, the visual acuity is 20/200 in each eye. The bulbar and palpebral conjunctiva is markedly injected with a watery mucous discharge (illustrated). The corneas are hazy with blurred iris detail. There is a 6 mm oval area of blanched bulbar conjunctiva inferiorly near the limbus. The anterior chambers are deep, and the pupils are round.



Question: What emergent action should be initiated prior to completing the ophthalmic examination?

- A. Emergent ophthalmology consultation
- B. Litmus test
- C. Irrigation of the eye with copious fluids such as saline or lactated Ringer's solution
- D. Tetanus prophylaxis
- E. Neutralization with a weak acid or base for a base- or acid-offending agent, respectively

See page 104 for Answer, Diagnosis, and Discussion.



ECG 2.

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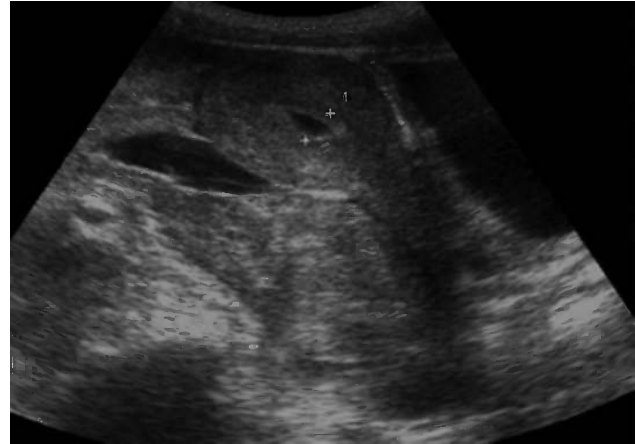
CASE 30 | Acute Abdominal Pain in Pregnancy

James H. Moak, MD, RDMS and John S. Rajkumar, MD

Case presentation: A 26-year-old female presents to the emergency department with pelvic cramping and vaginal spotting for the past 8 hours, and is triaged to the hallway. Her last menstrual period was 6 weeks ago. Her vital signs are normal. A urine pregnancy test is positive. On abdominal examination, she has mild lower abdominal tenderness without peritoneal signs. A transabdominal ultrasound is performed (see the illustration), while awaiting available space in the emergency department for further evaluation.

Question: Which of the following is true?

- A. The patient has a definitive intrauterine pregnancy based on the gestational sac noted on transabdominal scanning
- B. If the quantitative beta-human chorionic gonadotropin (hCG) is below a discriminatory level of 2000 mIU/mL, there is no role for sonography in the management of this patient
- C. The findings on transabdominal sonography could represent an ectopic pregnancy. If the quantitative beta-hCG is less than 2000 mIU/mL, transvaginal sonography will be unnecessary. The patient may be discharged with 48-hour follow-up in the obstetric/gynecology department
- D. A transvaginal ultrasound should be performed promptly to look for signs of an intrauterine



pregnancy or for further signs of an ectopic pregnancy. If no intrauterine yolk sac is present, obstetric/gynecology staff should be called for immediate evaluation

- E. The findings on transabdominal ultrasound suggest that a miscarriage has occurred. The patient's rhesus status must be checked to determine whether RhoGAM is needed prior to discharge.

See page 105 for Answer, Diagnosis, and Discussion.

CASE 31 | Coma Following Head Trauma

Andrew L. Homer, MD and William J. Brady, MD

Case presentation: A 19-year-old male presents to the emergency department 30 minutes after a motor vehicle collision in which he sustained a head injury. Emergency medical services reports that he has no recollection of the accident, and witnesses report that he was unconscious for approximately 1 minute. The patient is now alert and oriented to person, place, and time. He is complaining only of a headache at the site of impact. On examination, there is a 3 cm laceration on his left lateral forehead with an underlying bony step-off. The remainder of his physical examination is benign. Five minutes later, the patient

becomes increasingly lethargic, which progresses to a complete loss of consciousness. After stabilization, an emergent head computed tomography scan is ordered, which is shown in the figure.

Question: Which of the following statements is true?

- A. A lucid interval is seen in over 90% of patients with this condition
- B. This condition is more common in the elderly
- C. Extravagated blood crosses suture lines in this condition

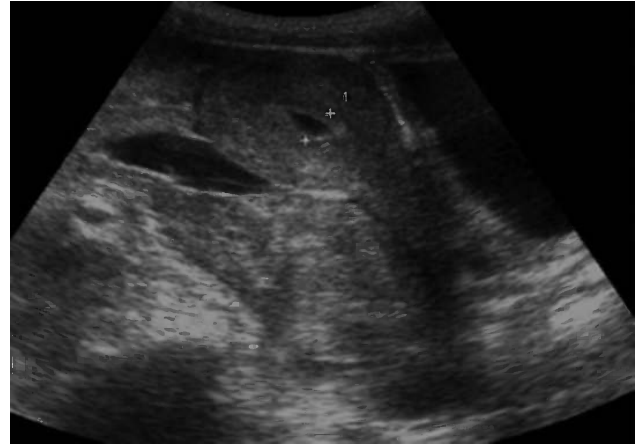
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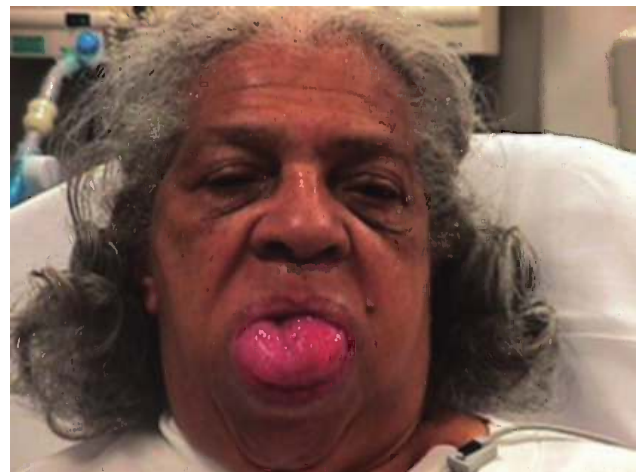
- D. Deaths are rare in patients with this condition if they are not in a coma preoperatively
- E. Venous blood is most common the source of the hematoma in this condition

See page 106 for Answer, Diagnosis, and Discussion.

CASE 32 | Tongue Swelling in a Hypertensive Female

Kevin S. Barlotta, MD and Alexander B. Baer, MD

Case presentation: A 60-year-old female with a history of hypertension presents to the emergency department with a complaint of progressive tongue swelling over the past 8 hours. She denies a change in diet, insect envenomation, or exposure to any new pets, detergents, or perfumes. She also denies any recent changes in medications. Currently, she is taking one prescription medication for her hypertension: lisinopril. She denies having difficulty breathing and is able to swallow her secretions. She reports one previous episode 1 week ago of lesser severity that spontaneously resolved. Her examination is significant for the marked tongue edema noted in the picture along with an inability to fully retract her tongue back into her mouth. The rest of her examination is unremarkable.



Question: What is the next most appropriate management strategy at this time?

- A. Reassurance and discharge to home with a prescription for a first-generation cephalosporin
- B. Emergent oral surgery consultation, blood cultures, and administration of a third-generation cephalosporin
- C. Admission to a monitored unit for observation, cessation of her lisinopril, and initiation of antihistamines and corticosteroids

- D. Computed tomography (CT) scan of the neck with intravenous contrast to evaluate for an abscess, and consultation with the ear–nose–throat service for emergent incision and drainage
- E. Chest CT to evaluate for a potential lesion obstructing venous drainage from the head through the superior vena cava

See page 107 for Answer, Diagnosis, and Discussion.



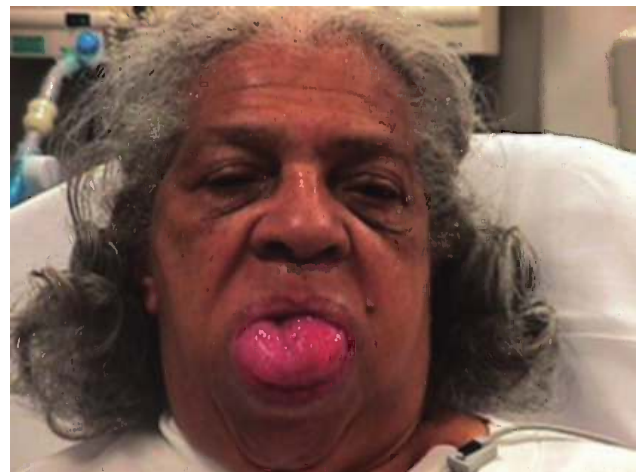
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See page 107 for Answer, Diagnosis, and Discussion.

CASE 33 | Purulent Eye Discharge in an Adult

Chris S. Bergstrom, MD and Alexander B. Baer, MD

Case presentation: A 32-year-old male is seen in the emergency department complaining of left eye pain and ocular discharge. On physical examination, the visual acuity is mildly decreased to 20/30 in the left eye. Pupil examination is normal. There is a thick, copious, purulent discharge present from the left eye, as noted in the illustration. The conjunctiva is injected and chemotic, but the cornea is clear.

Question: What is the appropriate treatment for this form of conjunctivitis?

- A. Topical acyclovir
- B. Topical erythromycin
- C. Intravenous ceftriaxone and topical ciprofloxacin
- D. Topical prednisolone
- E. Topical homatropine

See page 108 for Answer, Diagnosis, and Discussion.



CASE 34 | Shoulder Pain Following Direct Blow

Nathan P. Charlton, MD

Case presentation: A 41-year-old male with no significant past medical history was playing touch football with friends at his college reunion. He was running with the ball, twisted sideways to try to avoid being tagged, and fell on the lateral aspect of his left shoulder with his arm bent across his body. He experienced a sudden onset of pain in his left shoulder and decreased range of motion. He denies numbness, tingling, or weakness in the arm. On examination, he is tender to palpation over his acromioclavicular joint, there are no breaks in his skin, and he has pain with forced abduction of the arm. He was given ibuprofen for pain control, and an X-ray (illustrated) was obtained.

Question: The next most appropriate step in the management of this man's injury is:

- A. Orthopedic consultation for urgent surgical repair
- B. Figure-of-eight splint, pain control, and orthopedic follow-up
- C. Hematoma block and reduction
- D. Sling for immobilization and comfort, pain control, and outpatient follow-up



- E. Emergent computed tomography scan of the shoulder

See page 108 for Answer, Diagnosis, and Discussion.

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- B. Topical erythromycin
- C. Intravenous ceftriaxone and topical ciprofloxacin
- D. Topical prednisolone
- E. Topical homatropine

See page 108 for Answer, Diagnosis, and Discussion.



CASE 34 | Shoulder Pain Following Direct Blow

Nathan P. Charlton, MD

Case presentation: A 41-year-old male with no significant past medical history was playing touch football with friends at his college reunion. He was running with the ball, twisted sideways to try to avoid being tagged, and fell on the lateral aspect of his left shoulder with his arm bent across his body. He experienced a sudden onset of pain in his left shoulder and decreased range of motion. He denies numbness, tingling, or weakness in the arm. On examination, he is tender to palpation over his acromioclavicular joint, there are no breaks in his skin, and he has pain with forced abduction of the arm. He was given ibuprofen for pain control, and an X-ray (illustrated) was obtained.

Question: The next most appropriate step in the management of this man's injury is:

- A. Orthopedic consultation for urgent surgical repair
- B. Figure-of-eight splint, pain control, and orthopedic follow-up
- C. Hematoma block and reduction
- D. Sling for immobilization and comfort, pain control, and outpatient follow-up



- E. Emergent computed tomography scan of the shoulder

See page 108 for Answer, Diagnosis, and Discussion.

CASE 35 | A Gagging Child

Maureen Chase, MD and Worth W. Everett, MD

Case presentation: The mother of a 3-year-old boy presents to the emergency department with her son who refuses to eat today and gagged on the few bites of dinner he tried last night. She noted some mild drooling today but reports that he has otherwise been active and playful. She expresses concern that he may have swallowed something while playing unsupervised for a brief period yesterday afternoon. The child appears well, with normal phonation and no stridor. The remainder of his physical examination is unremarkable. You obtain the radiograph shown here.



Question: What is the next most appropriate management strategy?

- A. Order a computed tomography scan of the neck
- B. Consult an ear–nose–throat specialist for an emergent nasopharyngeal laryngoscopy
- C. Attempt to see if the child can drink and, if so, discharge him home with a repeat radiograph in 24 hours to determine if the object has passed
- D. Consult gastroenterology for emergent esophagoscopy
- E. Emergently intubate the child for airway protection

See page 109 for Answer, Diagnosis, and Discussion.



CASE 36 | Adult Male with a Sudden, Severe Headache

Andrew L. Homer, MD and William J. Brady, MD

Case presentation: A 55-year-old male presents to the emergency department complaining of the acute onset of a severe global headache while at rest 2 hours prior to presentation. The patient also complains of neck stiffness and nausea. Further history reveals the presence of milder headaches that have occurred intermittently over the past 2 weeks. His vital signs are significant for a blood pressure of 65/95 mmHg and a pulse of 90 beats per minute, and he is afebrile. The patient is in significant distress due to

pain; the remainder of the examination is normal. While awaiting further evaluation, he suddenly becomes unresponsive. A computed tomography (CT) scan of his head is performed emergently and shown in the illustration.

Question: Which of the following statements is true regarding this condition?

- A. Pressors should be administered to keep the mean systolic blood pressure above 160 mmHg

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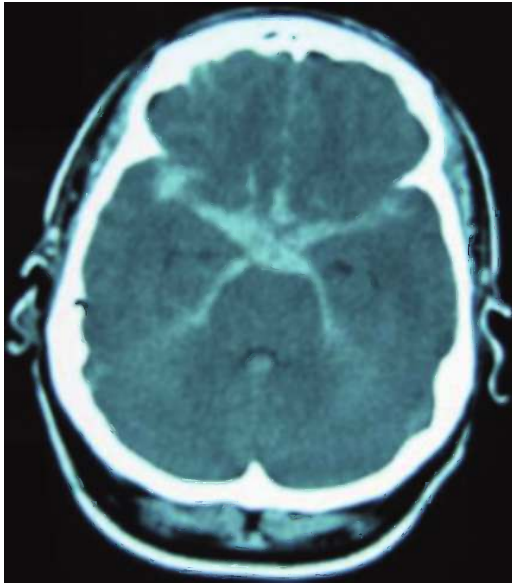
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Question: Which of the following statements is true regarding this condition?

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- B. Barbiturates are the antiseizure treatment of choice for this condition
- C. A classic “lucid interval” is present in one-third of patients who present early with this condition
- D. Lumbar puncture is the definitive treatment of choice for this patient
- E. A head CT may be falsely negative in as many of 10–15% of cases presenting early with headache

See page 110 for Answer, Diagnosis, and Discussion.

CASE 37 | New Facial Droop

Andrew D. Perron, MD and Christopher T. Bowe, MD

Case presentation: A 43-year-old female presents to the emergency department with a concern that she is having a stroke. She notes left facial weakness, pain in her left ear, and that whenever she drinks water it spills out the left side of her mouth. The symptoms have progressed over the past 24 hours. The photograph demonstrates the patient when she is asked to “smile and look up.”

Question: In the patient with this condition, which of the following medical treatments should be considered?

- A. Prednisone
- B. Gammaglobulin
- C. Thrombolytics
- D. Heparin
- E. Edrophonium

See page 111 for Answer, Diagnosis, and Discussion.

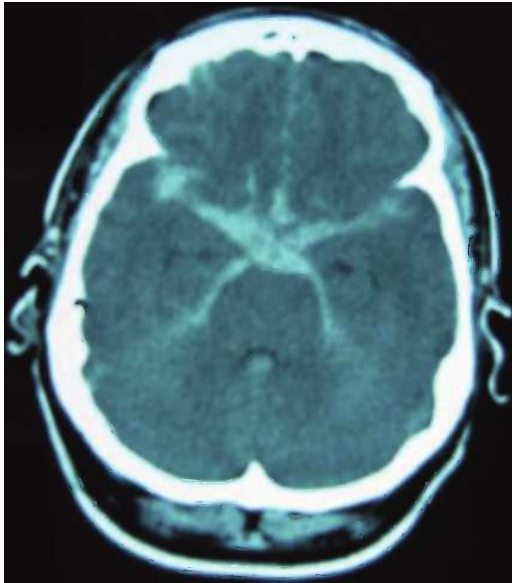


CASE 38 | Eye Pain After Tree Branch Strike

Chris S. Bergstrom, MD and Alexander B. Baer, MD

Case presentation: A 57-year-old patient presents to the emergency department complaining of sharp eye pain,

tearing, photophobia, and a foreign body sensation after being struck in the left eye with a tree branch.



- B. Barbiturates are the antiseizure treatment of choice for this condition
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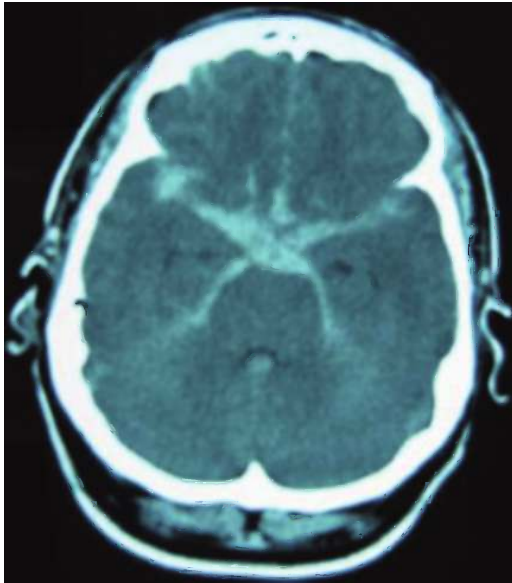


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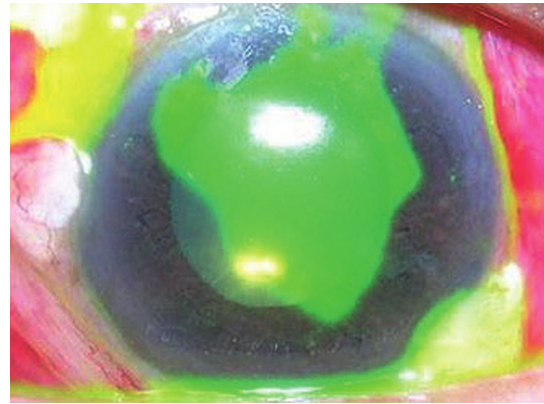
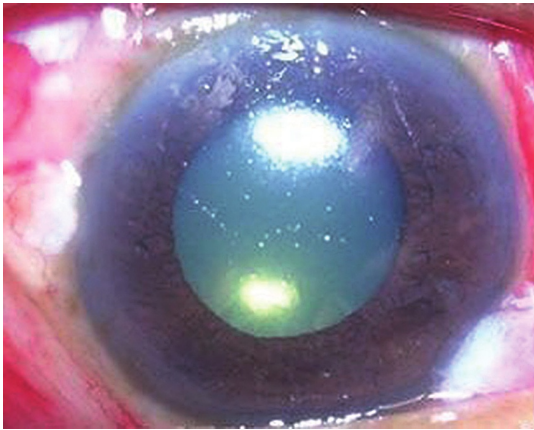
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Physical examination (first illustration) reveals mildly reduced visual acuity to 20/60 in the left eye. Pupillary examination is normal. The left upper eyelid is slightly edematous, and the conjunctiva is injected. The cornea is clear without evidence of an infiltrate. The anterior chamber is deep and clear. The iris and lens are normal.

Instillation of fluorescein reveals an epithelial staining defect with sharp borders measuring 8 mm × 7 mm in size (second illustration).



Question: Which of the following management plans is the next appropriate step?

- A. Perform magnetic resonance imaging of the orbit
- B. Administer adequate analgesics and topical antibiotics
- C. Perform an emergent lateral canthotomy
- D. Have the patient insert their contact lens
- E. Administer oral prednisone

See page 112 for Answer, Diagnosis, and Discussion.

CASE 39 | An Elderly Woman with Groin Pain

Brendan G. Carr, MD

Case presentation: A 65-year-old woman presents to the emergency department with the complaint of progressive groin and buttock pain over the last several months. There is no history of trauma or falls. She has curtailed her activities and is now unable to ambulate. Her past medical history is significant only for sarcoidosis and end-stage renal disease. She is currently taking prednisone. On examination, there is pain with range of motion and axial load of the left hip. This X-ray was obtained.

Question: All of the following are associated with this condition EXCEPT?

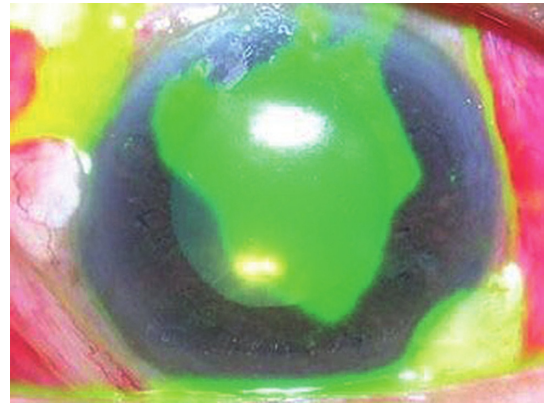
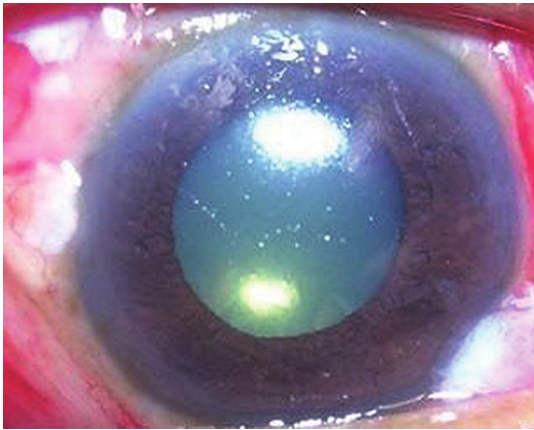
- A. Corticosteroids
- B. Sarcoidosis
- C. Sickle cell disease
- D. Previous hip fracture or dislocation
- E. Renal disease



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See page 113 for Answer, Diagnosis, and Discussion.

CASE 40 | Rash and Joint Pain in a Child

Mara L. Becker, MD

Case presentation: An 8-year-old boy presents to the emergency department with a rash for 2 days and an inability to ambulate due to bilateral ankle pain. The family reports that the rash began on his legs and is now more generalized. It is neither painful nor pruritic. The child appears well, with normal vital signs. The skin lesions (pictured) are palpable and purple in hue and do not blanch with pressure. The ankles are warm to the touch and have minimal periarticular swelling, but no intra-articular fluid. On examination, the right wrist is also painful and warm with periarticular swelling. The rest of the examination is normal. Laboratory tests reveal a normal complete blood count, coagulation studies, electrolytes, and urinalysis. A blood culture is pending.

Question: What would be your next step in managing this patient?

- A. Discharge home with close follow-up with the primary care doctor and anti-inflammatory medications for the joint pain

- B. Admit for observation
C. Admit for intravenous antibiotic therapy
D. Consult orthopedics for an ankle arthrocentesis
E. Administer subcutaneous epinephrine (adrenaline)

See page 113 for Answer, Diagnosis, and Discussion.



CASE 41 | Radiology Findings after Laparoscopy

Munish Goyal, MD

Case presentation: A 65-year-old male presents to the emergency department with mild abdominal pain. He is 2 days post laparoscopic cholecystectomy and notes pain at one of his incision sites, which worsens when he ambu-

lates. He is tolerating a normal diet without nausea or vomiting, had a normal bowel movement today, and is urinating without difficulty. His abdominal incisions are healing well without erythema, fluctuance, or drainage.

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His abdomen is soft, with mild incision tenderness and normal bowel sounds, and without distention. A plain film (illustrated) has been ordered from triage.

Question: The X-ray findings are consistent with which of the following?

- A. Pneumonia
- B. Postoperative pneumoperitoneum
- C. Large bowel obstruction
- D. Biliary air
- E. Kidney stone

See page 114 for Answer, Diagnosis, and Discussion.



CASE 42 | Postprandial Abdominal Pain in an Elderly Woman

Hoi K. Lee, MD

Case presentation: A 70-year-old woman presents to the emergency department with a 1-week history of progressive abdominal pain and intermittent vomiting. She had a previous history of bloating and intermittent postprandial abdominal pain. She has never had surgery. On examination, her abdomen is mildly distended and tympanic, bowel sounds are normal, and the abdomen is moderately tender to palpation in the right upper quadrant. Abdominal X-rays shows distended loops of small bowel and gas within the liver in a branching pattern. An abdominal computed tomography scan with intravenous and oral contrast reveals the image shown here.

Question: Which of the following is true regarding this condition?

- A. Less than one-third of patients with this condition have a previous history of biliary symptoms, and overall mortality is less than 1%
- B. This condition accounts for less than 5% of all nonstrangulated small bowel obstructions seen in the general population
- C. Its diagnosis prompts outpatient follow-up with a surgical consultation



- D. Plain abdominal X-ray is usually sufficient to make the diagnosis
- E. Rigler's triad consists of large bowel obstruction, pneumobilia, and adhesions of the large bowel

See page 115 for Answer, Diagnosis, and Discussion.

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CASE 43 | “Pink Eye” in a Contact Lens Wearer

Chris S. Bergstrom, MD and Alexander B. Baer, MD

Case presentation: A 27-year-old soft contact lens wearer presents with a complaint of redness, blurred vision, pain, and photophobia in her right eye. The patient admits to “overwearing” her contact lenses, and sleeps in them on a regular basis. She also states that her eyes are matted together in the morning.

On physical examination, visual acuity is reduced to 20/100 in the right eye. The pupil examination is normal. The conjunctiva is injected, and there is a 4mm oval, white, fluffy, opacity on the cornea as noted in the figure.

Slit-lamp examination reveals cell and flare in the anterior chamber. The iris and lens detail are obscured by the opacity but are otherwise normal.

Question: What is the appropriate management for this condition?

- A. Topical steroid
- B. Topical antiviral agent
- C. Topical antibiotics



- D. Burr removal of this foreign body
- E. Oral antiviral agent

See page 115 for Answer, Diagnosis, and Discussion.

CASE 44 | Suspicious Hand Pain

Rex G. Mathew, MD

Case presentation: A 38-year-old man presents to the emergency department on a Saturday night with an injury to his right hand. He states that he simply bumped his hand on a bar stool. On examination, there is swelling over the dorsum of the hand and tenderness over his right fifth metacarpal; the motor, sensory, and vascular examinations are normal. An X-ray is obtained (see illustration).

Question: What is the next most appropriate management strategy at this time?

- A. Reassure the patient that there is no fracture and discharge him with analgesics and ice
- B. Admit the patient for emergent orthopedic surgical repair
- C. Splint the patient and discharge with orthopedic referral
- D. Admit the patient for intravenous antibiotics given the almost certain chance that this represents a “fight bite”
- E. Admit the patient for rheumatologic evaluation

See page 116 for Answer, Diagnosis, and Discussion.



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See page 116 for Answer, Diagnosis, and Discussion.



CASE 45 | Fever and Rash in a Child

David L. Eldridge, MD

Case presentation: A 2-year-old male is brought to the emergency department with a 6-day history of fever (temperatures up to 38.4°C) and irritability. Accompanying this fever is the rash pictured. This rash is distributed along his face, his trunk, and the flexural surfaces of his extremities. He also has nonexudative conjunctivitis and dry, cracked, erythematous lips. With palpation of his neck, you discover that he has a large (2.0 cm), firm, mobile, tender, left-sided anterior cervical lymph node. His hands and feet appear edematous.

Question: Which of the following is associated most closely with this clinical syndrome?

- A. Hemorrhagic gastritis
- B. Acute renal failure
- C. Intracranial abscess
- D. Coronary artery aneurysms
- E. Pancytopenia

See page 117 for Answer, Diagnosis, and Discussion.



CASE 46 | An Alcoholic with Dyspnea

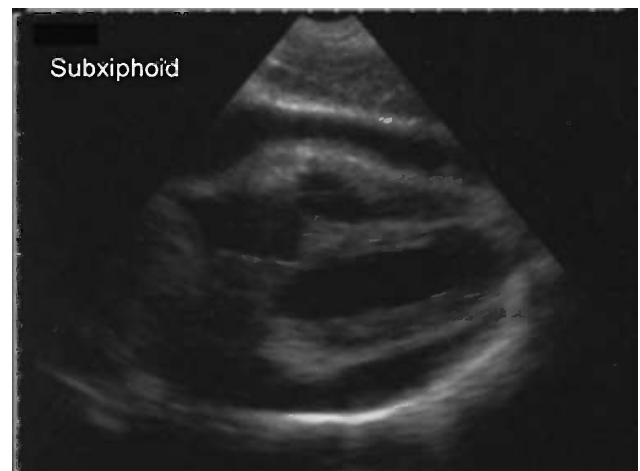
James H. Moak, MD, RDMS and John S. Rajkumar, MD

Case presentation: A 50-year-old female with a history of alcohol abuse presents complaining of shortness of

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Apical four-chamber view.



Subxiphoid view.

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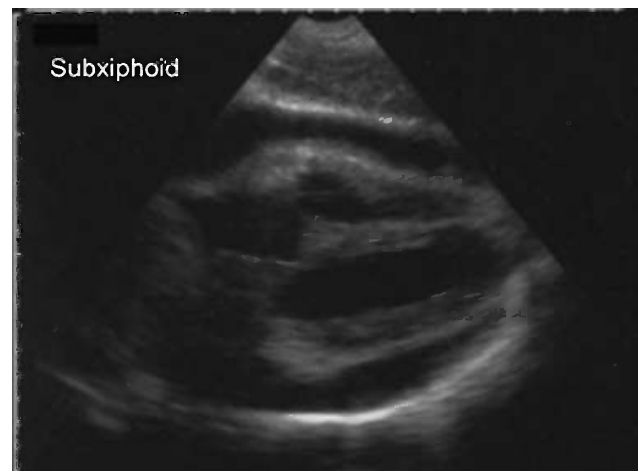
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Apical four-chamber view.



Subxiphoid view.



Right upper quadrant view.



Midline sagittal view of abdomen.

a heavy smoker and is noncompliant with medications for hypertension. The patient denies trauma but has contusions and abrasions on her hands and arms in various stages of healing. Her vitals are: blood pressure 106/85 mmHg, heart rate 124 beats per minute, respiration 32 breaths per minute. Pulse oximetry is 90% on 2L nasal cannula. With examination limited by the patient's inability to cooperate, the following are noted: dry mucous membranes, no jugular venous distention, distant heart sounds, and grossly symmetric breath sounds. The bedside ultrasound images shown here are obtained by the examining physician.

Question: Which of the following is true?

- A. With these images, the patient should be sent for emergent computed tomography of her head to exclude intracranial vascular catastrophe as a cause for her abnormal mental status
- B. These images demonstrate intraperitoneal fluid suggestive of hemorrhage. Whether this is due to acute aortic aneurysm or occult trauma, the patient requires immediate surgical evaluation for possible emergent operative management
- C. These images, combined with the absence of muffled heart sounds, jugular venous distention, and hypotension, make tamponade exceedingly unlikely
- D. These images show pericardial effusion with evidence of dissection in the abdominal aorta. This suggests an acute proximal dissection, mandating immediate consultation with a cardiothoracic surgeon for operative repair
- E. These images show large pericardial effusion. The diagnosis of tamponade will be made based on a dynamic assessment of cardiac filling during diastole

See page 118 for Answer, Diagnosis, and Discussion.

CASE 47 | Dark Urine from an Immigrant

Suzanne M. Shepherd, MD and William H. Shoff, MD

Case presentation: A 38-year-old Egyptian male complains of progressive fatigue, skin and eye yellowing, crampy abdominal and low back pain, and darker urine over the last 2 days. He denies similar previous episodes. He notes no recent travel and no use of prescription or illicit drugs or herbal medicines. He denies ingestion of alcohol or raw or tainted foods. He ate baked fish and lightly boiled broad beans approximately 16 hours prior to the onset of illness. Vital signs are remarkable only

for a pulse of 108 beats per minute. His conjunctivae are pictured here; abdominal examination reveals mild diffuse tenderness. The spun urine is also illustrated.

Question: Which of the following tests would be the most appropriate next step in his evaluation?

- A. Noncontrast computed tomography scan to evaluate for nephrolithiasis
- B. Urine microscopy and peripheral blood smear



Right upper quadrant view.



Midline sagittal view of abdomen.

a heavy smoker and is noncompliant with medications for hypertension. The patient denies trauma but has contusions and abrasions on her hands and arms in various stages of healing. Her vitals are: blood pressure 106/85 mmHg, heart rate 124 beats per minute, respiration 32 breaths per minute. Pulse oximetry is 90% on 2L nasal cannula. With examination limited by the patient's inability to cooperate, the following are noted: dry mucous membranes, no jugular venous distention, distant heart sounds, and grossly symmetric breath sounds. The bedside ultrasound images shown here are obtained by the examining physician.

Question: Which of the following is true?

- A. With these images, the patient should be sent for emergent computed tomography of her head to exclude intracranial vascular catastrophe as a cause for her abnormal mental status
- B. These images demonstrate intraperitoneal fluid suggestive of hemorrhage. Whether this is due to acute aortic aneurysm or occult trauma, the patient requires immediate surgical evaluation for possible emergent operative management
- C. These images, combined with the absence of muffled heart sounds, jugular venous distention, and hypotension, make tamponade exceedingly unlikely
- D. These images show pericardial effusion with evidence of dissection in the abdominal aorta. This suggests an acute proximal dissection, mandating immediate consultation with a cardiothoracic surgeon for operative repair
- E. These images show large pericardial effusion. The diagnosis of tamponade will be made based on a dynamic assessment of cardiac filling during diastole

See page 118 for Answer, Diagnosis, and Discussion.

CASE 47 | Dark Urine from an Immigrant

Suzanne M. Shepherd, MD and William H. Shoff, MD

Case presentation: A 38-year-old Egyptian male complains of progressive fatigue, skin and eye yellowing, crampy abdominal and low back pain, and darker urine over the last 2 days. He denies similar previous episodes. He notes no recent travel and no use of prescription or illicit drugs or herbal medicines. He denies ingestion of alcohol or raw or tainted foods. He ate baked fish and lightly boiled broad beans approximately 16 hours prior to the onset of illness. Vital signs are remarkable only

for a pulse of 108 beats per minute. His conjunctivae are pictured here; abdominal examination reveals mild diffuse tenderness. The spun urine is also illustrated.

Question: Which of the following tests would be the most appropriate next step in his evaluation?

- A. Noncontrast computed tomography scan to evaluate for nephrolithiasis
- B. Urine microscopy and peripheral blood smear



- C. Emergent endoscopic retrograde cholangiopancreatography
- D. Ultrasound of the gallbladder

- E. Chest and abdominal flat plate X-ray

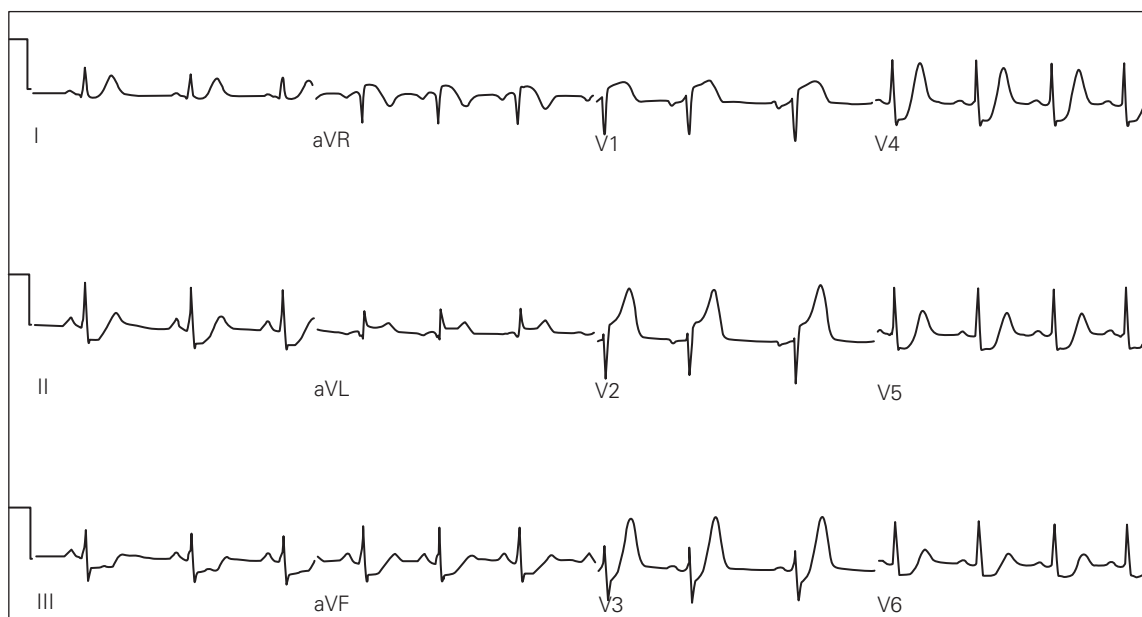
See page 120 for Answer, Diagnosis, and Discussion.

CASE 48 | Chest Pain and Lead aVR ST Segment Elevation

William J. Brady, MD

Case presentation: A 47-year-old male without a past medical history presented to the emergency department with chest pain. The pain had occurred earlier in the day

and resolved spontaneously; then it had recurred approximately 90 minutes prior to arrival. The physical examination revealed an anxious-appearing adult male with





- C. Emergent endoscopic retrograde cholangiopancreatography
- D. Ultrasound of the gallbladder

- E. Chest and abdominal flat plate X-ray

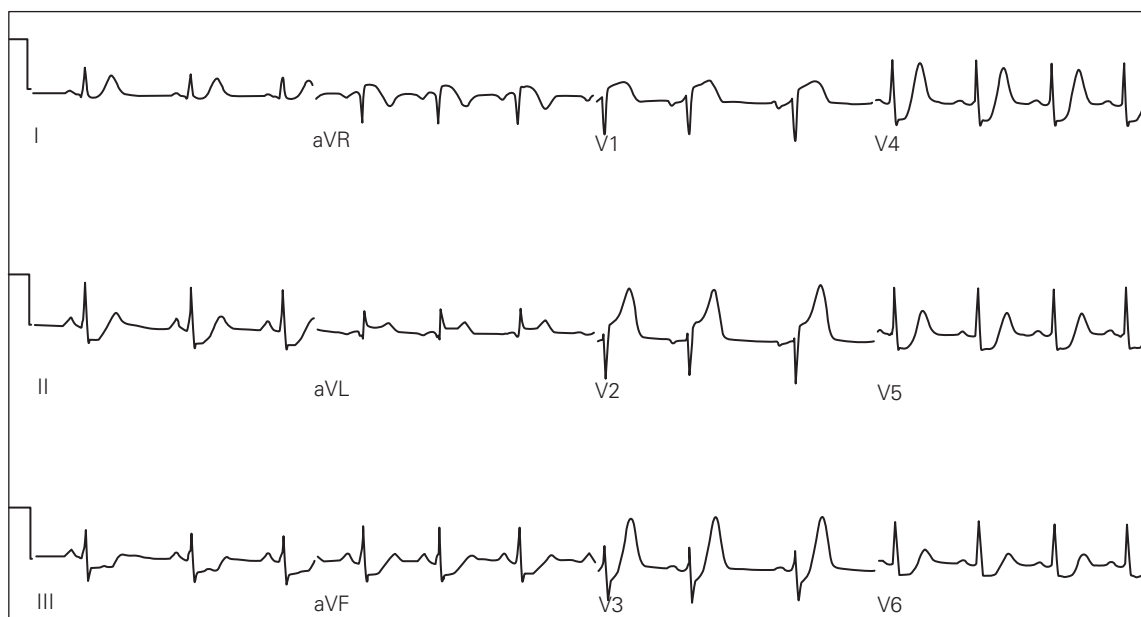
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and resolved spontaneously; then it had recurred approximately 90 minutes prior to arrival. The physical examination revealed an anxious-appearing adult male with



significant diaphoresis but was otherwise unremarkable. His 12-lead ECG is shown here.

Question: The use of the ECG can aid in risk prognostication in patients with acute coronary syndrome (ACS). Indicate which statement below is *incorrect* regarding risk assessment with respect to the ECG in the patient with ACS:

- A. Reciprocal change is a marker of increased risk in STEMI (ST elevation myocardial infarction) patients
- B. ST segment elevation in lead aVR predicts a high-risk lesion

- C. Isolated ST segment elevation in lead aVL predicts a poor outcome in the STEMI patient
- D. Left bundle branch block is a marker of increased risk in ACS patients
- E. Left ventricular hypertrophy is a marker of increased risk in ACS patients

See page 121 for Answer, Diagnosis, and Discussion.

CASE 49 | Hand Pain after Striking a Wall

William J. Brady, MD and Kevin S. Barlotta, MD

Case presentation: A 24-year-old intoxicated male presents to the emergency department after striking a wall with his hand at an oblique angle. He noted significant pain at onset but denies any other complaints. On examination, the hand demonstrates significant tenderness and soft tissue swelling in the medial-dorsal area. Radiographs, an anteroposterior view of the hand/wrist and lateral view of the hand/wrist, have been obtained and are shown here.



Question: The most appropriate diagnosis to describe this injury is:

- A. Closed fist injury with a “fight bite”
- B. Scaphoid fracture
- C. Carpometacarpal dislocation
- D. Scapholunate dissociation
- E. Radial head fracture

See page 122 for Answer, Diagnosis, and Discussion.

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- D. Scapholunate dissociation
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See page 122 for Answer, Diagnosis, and Discussion.

CASE 50 | A Refugee with Skin Lesions

Roger A. Band, MD and Jeanmarie Perrone, MD

Case presentation: A 17-year-old Cambodian is brought for evaluation, accompanied by his grandmother, with complaints of a nonproductive cough, rhinorrhea and low grade fever to 38°C. Although the grandmother speaks minimal English, his mother soon arrives and is able to help with additional history. She does not report any behavioral changes, trauma, or complaints of abdominal pain or arthralgias. On examination, he appears generally well, with the exception of signs consistent with a viral upper respiratory tract infection and the patterned lesions on his trunk pictured here.

Question: What is the most appropriate management strategy at this time?

- A. Give the child's mother appropriate return precautions and follow-up instructions, and reassure her that his upper respiratory tract complaints will typically resolve in 2–3 days
- B. Order a complete blood count, blood culture, and urinalysis
- C. Call social work and child protective services
- D. Order a skeletal survey



- E. Discharge home with an antibiotic cream to be applied to the skin lesions

See page 123 for Answer, Diagnosis, and Discussion.

CASE 51 | Pain out of Proportion to Examination

J. Michael Kowalski, DO and Adam K. Rowden, DO

Case presentation: A 47-year-old female presents with severe leg pain and swelling over the past 12 hours. She was working in her yard 2 days ago and sustained a small puncture wound to the area. She describes the initial



wound as trivial. The day after the original injury, the pain began and steadily increased; she now cannot bear weight or ambulate. She has had low-grade fevers at home along with generalized malaise. Her vitals are significant for pulse 125 beat per minute, blood pressure 88/43 mmHg, respiration 28 breaths per minute, and temperature 38.1°C. Physical examination of her leg is pictured here. Her examination is limited by the extreme pain induced with even light touch and passive motion of her leg.

An X-ray is obtained and is shown here.

Question: Which of the following is the next best management step?

- A. Admission to the intensive care unit for close monitoring

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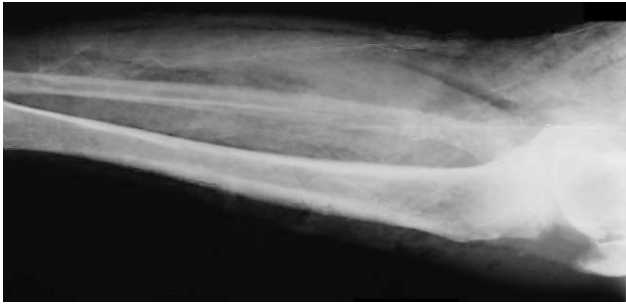


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An X-ray is obtained and is shown here.

Question: Which of the following is the next best management step?

- A. Admission to the intensive care unit for close monitoring



- B. Administer oral antibiotics and arrange outpatient follow-up in 1 week
- C. Emergent surgical consultation for wound debridement
- D. Obtain computed tomography imaging of the patient's leg
- E. Tetanus prophylaxis followed by thorough wound irrigation

See page 123 for Answer, Diagnosis, and Discussion.

CASE 52 | Leg Pain Following a Motor Vehicle Collision

Nathan P. Charlton, MD

Case presentation: A 34-year-old male is brought by helicopter to the emergency department after involvement in a motor vehicle crash. The medics report significant damage to the car requiring a prolonged extrication. The patient is awake and alert. He complains of severe pain in his left lower extremity but denies other complaints. His external examination is noted in the illustration, and his pulses and sensation are intact in both lower extremities.

Question: Which of the following statements is true?

- A. This patient likely has an isolated lower extremity injury
- B. An emergent orthopedic consultation should be obtained prior to completion of a trauma evaluation
- C. Lower extremity angiography should be performed immediately
- D. This patient could have a femoral shaft fracture in addition to a hip fracture
- E. Immediate hematoma block and fracture reduction should be performed

See page 124 for Answer, Diagnosis, and Discussion.

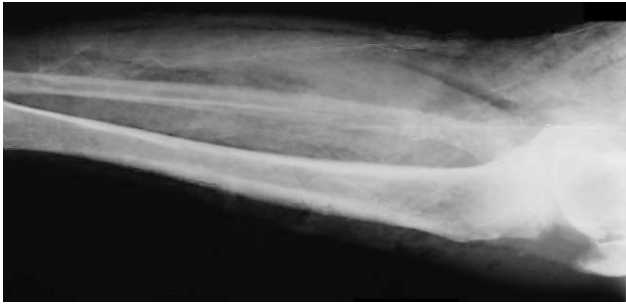


CASE 53 | Deformed Globe Following Trauma

Worth W. Everett, MD

Case presentation: A 79-year-old female was punched in the face during an assault and complains of pain and

decreased vision in her left eye. On physical examination, the affected eye has minimal light perception, and



- B. Administer oral antibiotics and arrange outpatient follow-up in 1 week
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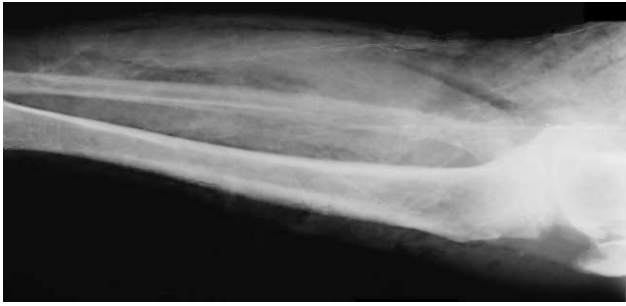


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extraocular movements are decreased. Examination of the pupil is limited by blood in the anterior chamber. The injuries are shown in the photographs.



Question: Which of the following is the appropriate next step in the management of this patient?

- A. Assess intraocular pressure
- B. Administer ocular steroids
- C. Perform bedside ocular ultrasound to better assess for internal injury
- D. Administer antiemetics and opioids, and call ophthalmology for an emergent consultation
- E. Perform emergent lateral canthotomy

See page 125 for Answer, Diagnosis, and Discussion.

CASE 54 | Foot Pain Following Breaking

Munish Goyal, MD

Case presentation: A 22-year-old female presents to the emergency department with left foot pain. She was the restrained driver of a car that struck another vehicle head on. She used her left foot to compress the brake pedal just prior to impact. She complains of decreased movement of her toes and says she cannot walk on her left foot. She denies loss of consciousness or any other complaints. Her foot appears mildly swollen, is exquisitely tender along the midfoot, and has normal distal pulses and capillary refill. The following foot radiographs were ordered from triage.

Question: What is the most appropriate management strategy at this time?

- A. Place the patient in a posterior splint, give her crutches, and refer her to an orthopedic specialist as an outpatient
- B. Obtain an orthopedic consultation, send preoperative laboratory specimens, and offer the patient analgesics
- C. Obtain an emergent angiogram to rule out a vascular injury
- D. Obtain an emergent orthopedic consultation, administer conscious sedation, and perform an emergent reduction



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- E. Administer a hematoma block and perform an emergent reduction

See page 126 for Answer, Diagnosis, and Discussion.



CASE 55 | Lamp Oil Ingestion

David L. Eldridge, MD

Case presentation: A 2-year-old male is brought by ambulance to the emergency department. About 30 minutes before presentation, his mother had found him next to a soda bottle that contained lamp oil. The bottle was spilled on the floor, and she could smell lamp oil on the boy's breath. The child was also coughing and choking. His mother called for an ambulance. Upon arrival, the emergency personnel found that the child appeared sleepy but was still coughing. On 2L per minute of oxygen delivered by nasal cannula, his oxygen saturation is 89% with a respiratory rate of 55 breaths per minute. He has prominent subcostal retractions. Auscultation of his lungs reveals crackles bilaterally and decreased lung sounds at both bases.

The chest radiograph shown here was taken 1 hour after the ingestion.



Question: Which of the following is most appropriate at this point in the management of this patient?

- A. Immediate gastric lavage as presentation is still within 1 hour of ingestion
- B. Intravenous broad-spectrum antibiotics given prophylactically
- C. Intravenous high-dose corticosteroids given prophylactically
- D. Continued close monitoring and supportive care
- E. Place a nasogastric tube and give activated charcoal

See page 127 for Answer, Diagnosis, and Discussion.

CASE 56 | Intermittent Abdominal Pain in a Female

John S. Rajkumar, MD and James H. Moak, MD, RDMS

Case presentation: A 32-year-old female presents with several hours of poorly defined abdominal pain. The pain has been intermittent for the previous 3 days and most

pronounced in the postprandial period. Her abdominal examination is significant for prominent tenderness in both the right upper and lower quadrants. Mild right

- E. Administer a hematoma block and perform an emergent reduction

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pronounced in the postprandial period. Her abdominal examination is significant for prominent tenderness in both the right upper and lower quadrants. Mild right



adnexal tenderness is noted on pelvic examination. The remainder of the examination is unremarkable. A pelvic ultrasound is normal. The patient's abdominal pain progresses while waiting for an abdominal computed tomography scan with contrast. Laboratory tests reveal a white blood cell count of $9,600/\text{mm}^3$; the serum chemistry, alanine aminotransferase, aspartate aminotransferase, and serum bilirubin are all normal. A bedside ultrasound of the right upper quadrant is performed, revealing the images shown here.

Question: Which of the following statements is most accurate?

- A. These images reveal a normal gallbladder
- B. These images reveal gallstones with an otherwise normal gallbladder, suggesting the diagnosis of

either biliary colic or asymptomatic stones unrelated to the patient's presenting complaint

- C. These images show no gallstones but demonstrate evidence of cholecystitis (i.e., acalculous cholecystitis)
- D. These images reveal gallstones with evidence of cholecystitis
- E. These images reveal gallstones and an abnormal gallbladder, but decisions regarding cholecystitis need to be made clinically, rendering it unlikely given the patient's history, examination, and laboratory findings

See page 127 for Answer, Diagnosis, and Discussion.

CASE 57 | Hallucinations in a Botanist

Joeseeph Forrester, MD and Christopher Holstege, MD

Case presentation: A 32-year-old male botanist presents to the emergency department after paramedics received a call from his spouse that he was becoming markedly confused. According to his wife, this occurred after he drank a tea made from one of his plants, with the plant utilized shown here.

The patient is notably agitated, following no commands, constantly moving in the stretcher, picking relentlessly at the bed sheets, and talking with incomprehensible, mumbling speech. The remainder of his examination is significant for the following: warm and dry to touch; no bowel sounds; pulse 140 beats per minute; blood pressure 160/90 mmHg; temperature 38.4°C . An examination of his lips and pupils is shown in the illustrations. A Foley catheter is placed, with a return of 1.5 L of urine.





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Question: Which of the following could produce this clinical syndrome?

- A. Jimson weed (*Datura stramonium*)
- B. Oleander (*Nerium oleander*)
- C. Lily of the valley (*Convallaria majalis*)
- D. Monkshood (*Aconitum napellus*)
- E. Death cap mushroom (*Amanita phalloides*)

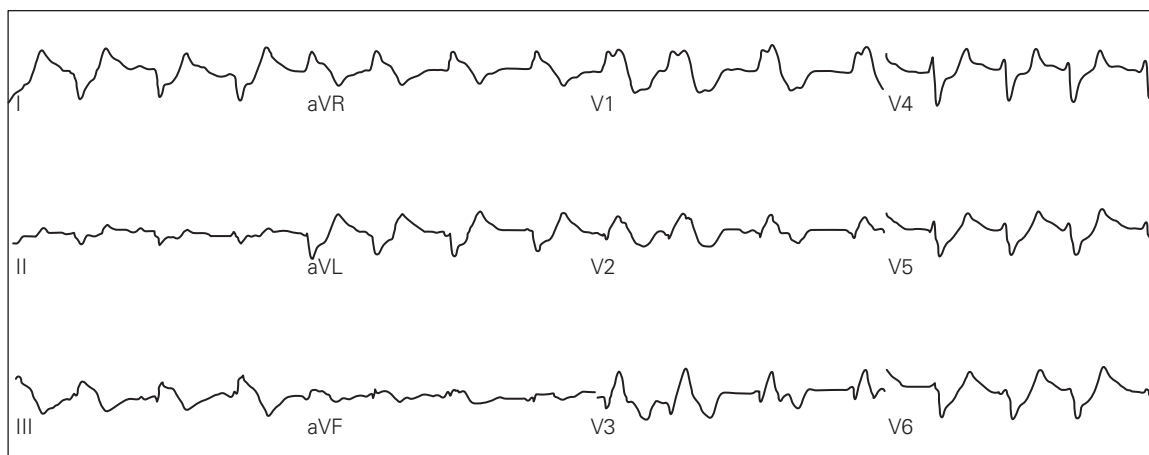
See page 128 for Answer, Diagnosis, and Discussion.

CASE 58 | Altered Mental Status with an Abnormal Electrocardiogram

William J. Brady, MD

Case presentation: A 36-year-old female presented to the emergency department via a private automobile with lethargy and weakness. Her past medical history and any

further details regarding the current history of present illness were unavailable. On examination, the patient was lethargic but arousable; vital signs were blood pressure





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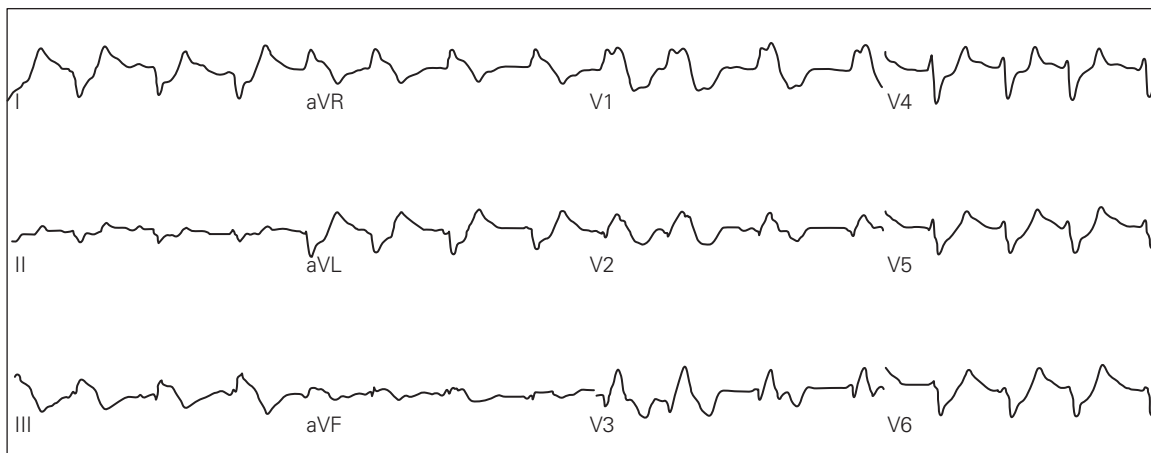
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100/70 mmHg, pulse 75 beats per minute, and respiration 16 breaths per minute. The remainder of the examination was unremarkable except for an apparent dialysis shunt in the left upper extremity. The ECG is shown.

Question: In this patient, the most likely diagnosis of this rhythm disturbance is:

A. Ventricular tachycardia

- B. Idioventricular rhythm
- C. Junctional rhythm with bundle branch block
- D. Sinoventricular rhythm
- E. Normal sinus rhythm

See page 129 for Answer, Diagnosis, and Discussion.

CASE 59 | Fishing in the Stomach

Joseph D. Forrester, MD and Christopher P. Holstege, MD

Case presentation: A 3-year-old male was playing with a lead fishing sinker. His mother attempted to take it away from him when he suddenly began choking. By the time she reached her son, his choking had ceased and he was actively crying. He subsequently arrived to the emergency department asymptomatic. His physical examination was unremarkable. The X-ray illustrated here was obtained.

Question: Which of the following is the next most appropriate management step for this patient?

- A. Gastrointestinal lavage
- B. Endoscopic removal
- C. Whole bowel irrigation
- D. Activated charcoal administration
- E. Syrup of ipecac administration

See page 131 for Answer, Diagnosis, and Discussion.



CASE 60 | Overdose-induced Boiled Lobster Skin

Heather A. Borek, MD and Christopher P. Holstege, MD

Case presentation: A 56-year-old alcoholic male presents with a decreased level of responsiveness and a diffuse rash. His girlfriend reported seeing him 5 days ago mixing a roach killer with water and threatening to kill himself; however, she never witnessed him drinking it. He was noted to have an episode of blue-green emesis later that day. His vital signs are significant for pulse 129 beats per minute, respiration 30 breaths per minute, blood pressure 92/43 mmHg, and temperature

37.3°C. His physical examination is significant for a comatose male with full body erythema and desquamation (see illustration).

Question: What substance is most likely responsible for his signs and symptoms?

- A. Hydrochloric acid
- B. Selenious acid
- C. Hydrofluoric acid

100/70 mmHg, pulse 75 beats per minute, and respiration 16 breaths per minute. The remainder of the examination was unremarkable except for an apparent dialysis shunt in the left upper extremity. The ECG is shown.

Question: In this patient, the most likely diagnosis of this rhythm disturbance is:

A. Ventricular tachycardia

- B. Idioventricular rhythm
- C. Junctional rhythm with bundle branch block
- D. Sinoventricular rhythm
- E. Normal sinus rhythm

See page 129 for Answer, Diagnosis, and Discussion.

CASE 59 | Fishing in the Stomach

Joseph D. Forrester, MD and Christopher P. Holstege, MD

Case presentation: A 3-year-old male was playing with a lead fishing sinker. His mother attempted to take it away from him when he suddenly began choking. By the time she reached her son, his choking had ceased and he was actively crying. He subsequently arrived to the emergency department asymptomatic. His physical examination was unremarkable. The X-ray illustrated here was obtained.

Question: Which of the following is the next most appropriate management step for this patient?

- A. Gastrointestinal lavage
- B. Endoscopic removal
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- D. Boric acid
- E. Chromic acid

See page 132 for Answer, Diagnosis, and Discussion.

CASE 61 | Back Pain Following a Fall

Andrew D. Perron, MD and Christopher T. Bowe, MD

Case presentation: A 78-year-old male patient presents to the emergency department after falling 7 feet from a ladder onto the ground. He noted immediate pain in his lower back. Examination reveals high lumbar spinal tenderness. Neurologic examination is unremarkable. The radiograph shown here is obtained.

Question: Which of the following statements is true regarding the management of this patient?

- A. No further tests are necessary because the patient's neurologic examination is normal
- B. A computed tomography scan should be performed
- C. The patient should be placed in a plaster cast and discharged with adequate analgesics
- D. Ultrasound of the area should be performed to rule out a significant hematoma
- E. An epidural nerve block should be performed in the emergency department for pain control

See page 133 for Answer, Diagnosis, and Discussion.



CASE 62 | Painful Facial Rash

Chris S. Bergstrom, MD and Alexander B. Baer, MD

Case presentation: A 63-year-old male is seen in the emergency department complaining of a painful rash

over the left side of his forehead along with blurred vision, redness, and light sensitivity in his left eye. He



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states that his symptoms started yesterday. Ocular examination reveals a vesicular rash on the left side of the forehead that respects the midline and involves the upper lid but does not affect the tip of the nose. There is a mucous discharge present. Slit-lamp examination shows conjunctival injection. The cornea is clear without evidence of staining or infiltrates. The anterior chamber is deep and quiet. The iris and lens are normal.

Question: What is Hutchinson's sign?

- A. Scrapings of the rash demonstrate hyphae when exposed to potassium hydroxide
- B. Rash involvement of the tympanic membrane
- C. Fluorescence of the rash when placed under a Wood's lamp
- D. Rash involvement of the cornea
- E. Rash involvement of the nose



See page 134 for Answer, Diagnosis, and Discussion.

CASE 63 | Intense Wrist Pain Following Trauma

Rex G. Mathew, MD

Case presentation: A 21-year-old man complains of left wrist pain after falling from a 5-foot ladder onto his left hand. On examination, there is swelling and tenderness over his wrist, and the examination is limited due to pain over the dorsum of his hand. The motor function is strong, and the sensory and vascular examinations are otherwise normal. The wrist radiographs obtained are noted here.

Question: What is most likely injury?

- A. Scaphoid fracture
- B. Lunate dislocation
- C. Perilunate dislocation
- D. No fracture or dislocation – normal X-ray
- E. Fifth metacarpal fracture

See page 134 for Answer, Diagnosis, and Discussion.



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See page 134 for Answer, Diagnosis, and Discussion.



CASE 64 | Fever and Drooling in a Child

Sarah E. Winters, MD, MSCE and Brendan G. Carr, MD

Case presentation: An 18-month-old female presents with 2 days of fever and irritability. On the day of arrival to the emergency department, her mother reports that the child has developed new onset of drooling and decreased oral intake. Her past medical history is unremarkable. On physical examination, she is febrile, ill-appearing, and has neck stiffness. Illustrated here is the soft tissue lateral X-ray of the neck is obtained.

Question: What is the next most appropriate management strategy at this time?

- A. Discharge to home with supportive care
- B. Discharge to home with oral antibiotics
- C. Admit for intravenous antibiotics and surgical consultation
- D. Emergent intubation
- E. Cricothyroidotomy

See page 135 for Answer, Diagnosis, and Discussion.



CASE 65 | Syncope and Flank Pain in an Elderly Man

John S. Rajkumar, MD and James H. Moak, MD, RDMS

Case presentation: A 73-year-old man with a history of obesity, hypertension, and cigarette smoking presents to the emergency department after a syncopal episode. He complains of mild left-sided back and flank pain. He has a blood pressure of 118/94mmHg, a pulse of 96 beats per minute, and respiration of 20 breaths per minute. The physical examination is significant only for mild, diffuse abdominal tenderness. His urinalysis is normal. An ultrasound is performed to evaluate for abdominal aortic aneurysm (AAA). Image A shows a sagittal view of the aorta, and image B a transverse view at the level of the renal veins.

Question: Which of the following is true?

- A. The aorta imaged here has a normal diameter. This reduces the likelihood of AAA to less than 90%
- B. The patient has an AAA. If no intra-abdominal free fluid is found in the abdomen, acute aortic aneurysm rupture is excluded from the differential diagnosis



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- C. The patient has an AAA. Immediate surgical consultation and operative intervention are needed
- D. The patient has an AAA. Since the patient is comfortable and hemodynamically stable, he should be admitted for inpatient observation and further evaluation and imaging
- E. The aorta imaged here shows significant stenosis. Doppler flow analysis or angiography is needed to identify whether this is the cause of the patient's acute symptoms

See page 136 for Answer, Diagnosis, and Discussion.

CASE 66 | Get Them Undressed!

Munish Goyal, MD

Case presentation: A 19-year-old male is brought to the emergency department by his friends with signs of fever and confusion. The patient is lethargic and warm to touch. His friends state he was complaining of a headache this morning and became increasingly confused later in the day. He has no medical history and was having no symptoms yesterday. On examination, you note that he is hypotensive and tachycardic, and, upon fully undressing him, has the skin findings illustrated here.

Question: What is the next most appropriate management strategy at this time?

- A. Administer acetaminophen and order a routine computed tomography scan of the head to evaluate his headache
- B. Obtain a dermatology consultation
- C. Place the patient in isolation, administer immediate antibiotics, and draw appropriate cultures
- D. Order an ECG, alcohol level, electrolytes, and ammonia level to look for a source for his confusion
- E. Biopsy the skin lesion and send it to pathology



See page 137 for Answer, Diagnosis, and Discussion.



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See page 137 for Answer, Diagnosis, and Discussion.

CASE 67 | A “Blue Hue” Following Endoscopy

Saumil Vaghela, PharmD and Christopher P. Holstege, MD

Case presentation: A 39-year-old previously healthy female presents to the emergency department as a transfer from an outpatient endoscopy clinic. She had been in her usual state of health until 45 minutes into her esophagogastroduodenoscopy when she was noted to have a gradual decrease in her oxygen saturations and dyspnea. On arrival, her vital signs were as follows: pulse 125 beats per minute, blood pressure 96/43 mmHg, respiration 36 breaths per minute, and temperature 37.3°C. Her examination is unremarkable except for the skin findings pictured here (the patient’s hand is on the right, and the nurse’s hand on the left). Her lungs are clear, and her pulses are strong.

Question: Which of the following is the appropriate antidote for this toxicity?

- A. Prussian blue
- B. Physostigmine



- C. Deferoxamine
- D. Methylene blue
- E. Naloxone

See page 138 for Answer, Diagnosis, and Discussion.

CASE 68 | Acute-onset Blurred Vision

Chris S. Bergstrom, MD and Alexander B. Baer, MD

Case presentation: A 37-year-old male is seen in the emergency department with a complaint of blurred vision, redness, and a foreign body sensation in his right

eye. His symptoms started 3 days prior to presentation when he felt something hit his eye while working under his car. His visual acuity is 20/60 in the right eye, and the

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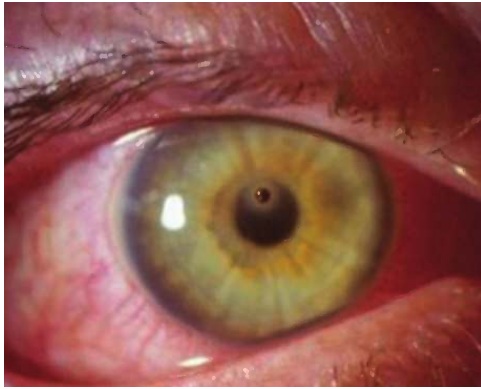
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pupillary examination is normal. The conjunctiva is injected, and there is a central, metallic corneal foreign body embedded 30% into the corneal stroma with an associated rust ring and infiltrate (pictured below). There



is 1+ cellular reaction in the anterior chamber. The iris and lens are normal.

Question: What is the next most appropriate step in the management of this patient?

- A. Magnetic resonance imaging of the eye to rule out an intraorbital foreign body
- B. Intraorbital injection of lidocaine prior to manipulation of the foreign body
- C. Eye irrigation and then discharge to home with an outpatient ophthalmology re-evaluation in 1 week
- D. Eye patch, antibiotics, and follow-up with the patient's primary physician in 3–5 days
- E. Removal of the ocular foreign body under topical anesthesia using a 25g needle

See page 139 for Answer, Diagnosis, and Discussion.

CASE 69 | Elbow Pain in a Child After a Fall

Elizabeth Cochran Ward, MD and Alexander B. Baer, MD

Case presentation: An 8-year-old child has fallen from a tree onto his right outstretched arm. He presents to the emergency department 2 hours after the accident with a complaint of elbow pain. The patient describes the pain as a constant ache that is exacerbated with any movement of the arm. On examination, there is moderate swelling localized to the elbow. Elbow pain occurs with passive movement. He has good strength in the hand, and his sensory and vascular examinations are normal.

Question: What does this lateral radiograph of the elbow reveal?

- A. Radial head dislocation
- B. Capitellum fracture
- C. Monteggia fracture
- D. Galeazzi fracture
- E. Anterior and posterior “fat pads”



See page 141 for Answer, Diagnosis, and Discussion.

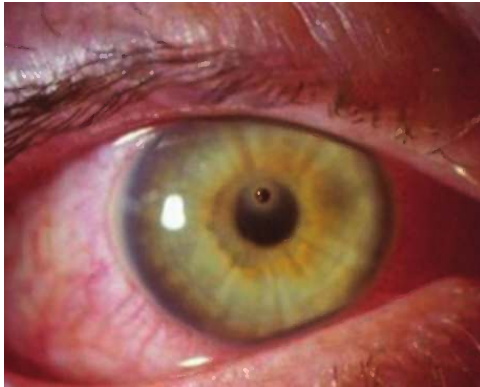
CASE 70 | Confusion, Anemia, and Abdominal Pain in a Toddler

Christopher P. Holstege, MD and Joseph T. Vance

Case presentation: A 4-year-old child was seen 3 weeks ago by his pediatrician for abdominal cramping and con-

stipation. The child is an immigrant from Africa and has no significant past medical history. The laboratory

pupillary examination is normal. The conjunctiva is injected, and there is a central, metallic corneal foreign body embedded 30% into the corneal stroma with an associated rust ring and infiltrate (pictured below). There



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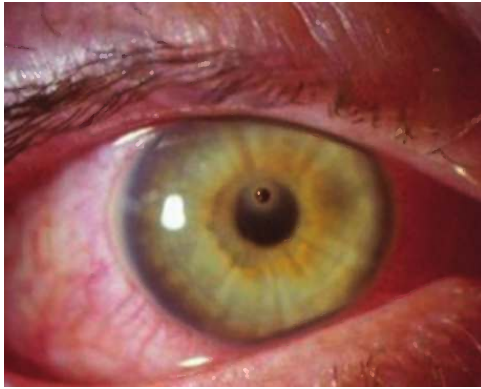
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Question: What is the treatment of choice for this child?

- A. D-Penicillamine
- B. 2,3-Dimercaptosuccinic acid (DMSA or succimer)
- C. Calcium disodium ethylenediaminetetraacetate (CaNa₂EDTA)
- D. Dimercaprol (British Antilewisite or BAL)
- E. Deferoxamine

See page 142 for Answer, Diagnosis, and Discussion.



CASE 71 | A Ground-level Fall with Ankle Pain

Christopher T. Bowe, MD

Case presentation: A 37-year-old male patient presents to the emergency department after falling while stepping off a curb. He reported a twisting motion of his left ankle and an inability to stand on his left leg since the fall. He denies any other injury. Radiographs were performed and are noted here.



Question: How can the injury, noted on the provided radiographs, be best described and initially managed?

- A. Nondisplaced fracture – splint with outpatient orthopedic follow-up
- B. Fracture/dislocation – reduction and splint with outpatient orthopedic follow-up

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Christopher T. Bowe, MD

Case presentation: A 37-year-old male patient presents to the emergency department after falling while stepping off a curb. He reported a twisting motion of his left ankle and an inability to stand on his left leg since the fall. He denies any other injury. Radiographs were performed and are noted here.



Question: How can the injury, noted on the provided radiographs, be best described and initially managed?

- A. Nondisplaced fracture – splint with outpatient orthopedic follow-up
- B. Fracture/dislocation – reduction and splint with outpatient orthopedic follow-up

- C. Unstable bimalleolar fracture – urgent orthopedic consultation
- D. Stable bimalleolar fracture – splint with outpatient orthopedic follow-up

- E. Unstable trimalleolar fracture – urgent orthopedic consultation

See page 143 for Answer, Diagnosis, and Discussion.

CASE 72 | Traumatic Eye Pain and Proptosis

Chris Bergstrom, MD and Alexander Baer, MD

Case presentation: A 32-year-old female is seen in the emergency department after a domestic altercation. She is complaining of left eye pain, swelling, and decreased vision. Ocular examination reveals visual acuity of 20/400 in the left eye with limited extraocular motility. An afferent pupillary defect is present in the left eye. There is marked proptosis of her left eye with periorbital edema and bullous subconjunctival hemorrhage, as noted in the photograph. The globe is hard, and there is resistance to retropulsion. The intraocular pressure is 65 mmHg in the left eye.



Question: Which of the following is not indicated in the treatment of this condition?

- A. Timolol
- B. Brimonidine
- C. Acetazolamide

- D. Lateral canthotomy
- E. Lisinopril

See page 144 for Answer, Diagnosis, and Discussion.

CASE 73 | Diffuse Ankle Pain Following a Fall

Andrew D. Perron, MD and Christopher T. Bowe, MD

Case presentation: A 21-year-old male patient presents to the emergency department with ankle and foot pain after jumping to the ground from a height of approximately 10 feet. He is unable to ambulate due to pain in the foot and ankle. Examination reveals ankle pain and tenderness over the deltoid ligament on the medial ankle. Neurovascular examination is normal. A radiograph has been performed (illustrated).

Question: In this patient with an axial load mechanism, palpable medial ankle tenderness, and the radiograph that is shown, what emergency department management course should be pursued in this scenario?

- A. Ace wrap, ice, elevation, and discharge home
- B. Aircast, weight-bearing as tolerated, and discharge home
- C. Splint, crutches, and primary care outpatient follow-up

- C. Unstable bimalleolar fracture – urgent orthopedic consultation
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See page 144 for Answer, Diagnosis, and Discussion.

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- C. Unstable bimalleolar fracture – urgent orthopedic consultation
- D. Stable bimalleolar fracture – splint with outpatient orthopedic follow-up

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- A. Ace wrap, ice, elevation, and discharge home
- B. Aircast, weight-bearing as tolerated, and discharge home
- C. Splint, crutches, and primary care outpatient follow-up



D. Potential further imaging (i.e., computed tomography scan) and orthopedic consultation

E. Hematoma block and fracture reduction

See page 145 for Answer, Diagnosis, and Discussion.

CASE 74 | Rash Following Brush Fire

Christopher P. Holstege, MD and Alejandro C. Stella, MD

Case presentation: A 9-year-old male presents to the emergency department with facial pain, erythema, and swelling. He was in his normal state of health until this morning when he awoke from sleep and noted a diffuse rash over his face with a marked burning sensation in the region of the rash. It has progressed through the day, involves only his face and neck, and stops at his shirt neck line. He has had no fevers, and his immunizations are up to date. He denies any other complaints. His best friend also awoke with the same rash. The previous day, while playing on the school playground, they watched a neighboring farm burning brush. Smoke from the fire blew over the area where they were watching. The boy's facial examination is pictured here.



Question: The rash is due to:

A. Type I allergic reaction

B. Type IV allergic reaction

C. Roseola (Sixth disease)

D. Rubella (German measles)

E. Rubeola (measles)

See page 146 for Answer, Diagnosis, and Discussion.



D. Potential further imaging (i.e., computed tomography scan) and orthopedic consultation

E. Hematoma block and fracture reduction

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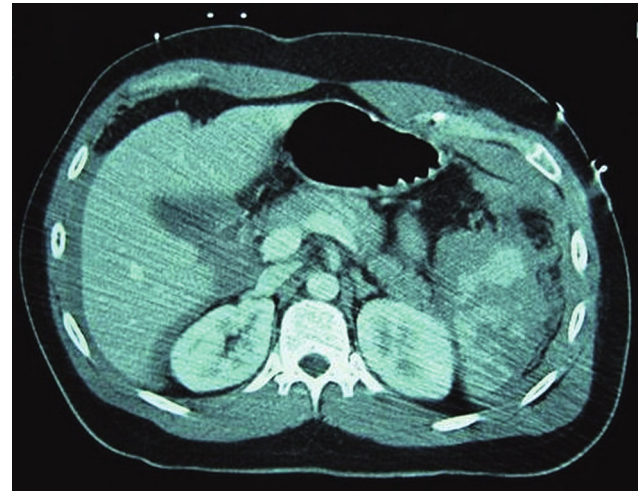
E. Rubeola (measles)

See page 146 for Answer, Diagnosis, and Discussion.

CASE 75 | Abdominal Pain in a Trauma Victim

Esther H. Chen, MD

Case presentation: A 25-year-old male unrestrained driver involved in a head-on collision with another vehicle presents with a complaint of chest and abdominal pain. There was no airbag deployment, and the car was moderately damaged. Vital signs are blood pressure 95/60 mmHg, pulse 120 beats per minute, respiration 20 breaths per minute, and oxygen saturation 100% on room air. The examination is significant for the skin finding



noted in the figure, crepitus over the left lateral chest wall, and left upper quadrant abdominal tenderness.

Question: Which statement is true regarding this injury?

- A. A FAST ultrasound examination is the most accurate for identifying abdominal solid organ injury
- B. Greater than 90% of splenic injuries are associated with rib fractures
- C. Patients with an initial negative computed tomography scan can still develop delayed splenic rupture 1 week after the initial injury
- D. The liver, not the spleen, is most commonly injured after blunt abdominal trauma
- E. These injuries almost always require operative repair

See page 147 for Answer, Diagnosis, and Discussion.

CASE 76 | Skin Target Lesion

Mara L. Becker, MD

Case presentation: A patient presents to your emergency department with a complaint that she has developed a new rash on her calf over the past 24 hours. It is erythematous with central clearing, and it has been expanding as the day progressed (see the photograph). It is nonpainful and nonpruritic. This is the only lesion she

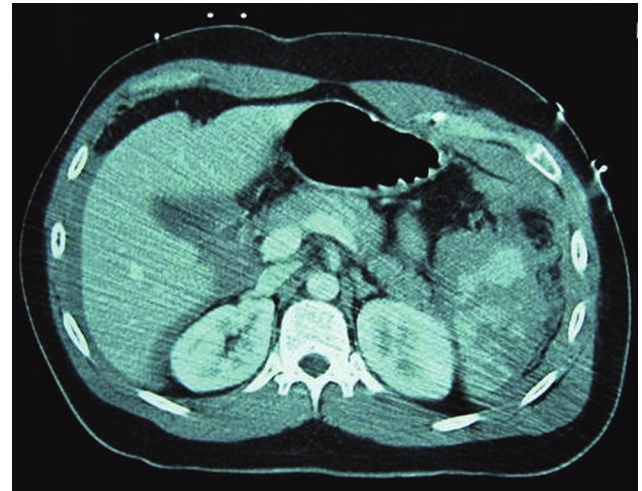
has found. She has had no fever and only complains of some mild fatigue and muscle aches after hiking at Valley Forge, Pennsylvania.

Question: Which of the following is the next correct step in her management?

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has found. She has had no fever and only complains of some mild fatigue and muscle aches after hiking at Valley Forge, Pennsylvania.

Question: Which of the following is the next correct step in her management?

- A. Send her home with instructions to remain in isolation until the rash resolves
- B. Initiate therapy with doxycycline
- C. Perform incision and drainage at the center of the target lesion
- D. Administer brown recluse spider antivenom
- E. Infuse intravenous gammaglobulin

See page 148 for Answer, Diagnosis, and Discussion.

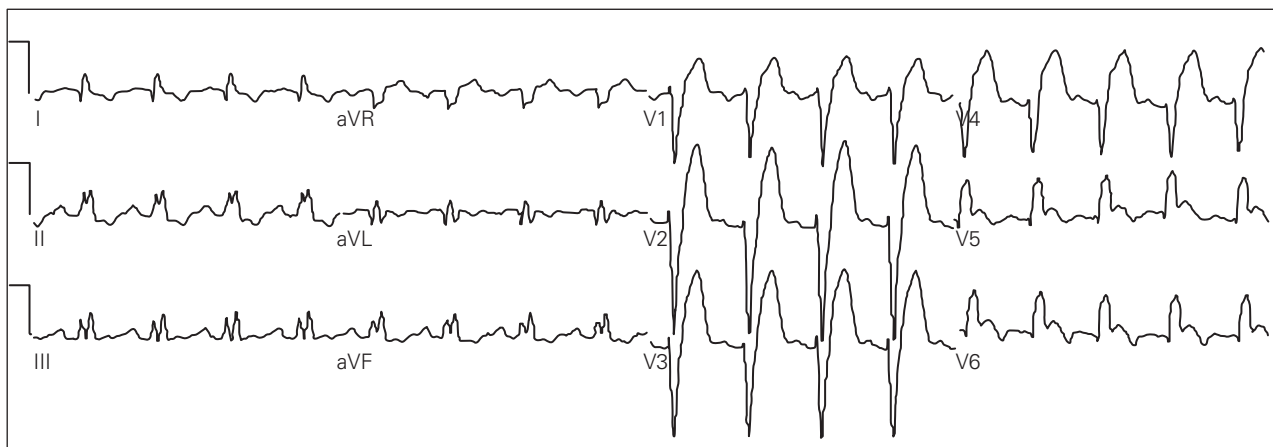


CASE 77 | Chest Pain and a Confounding Electrocardiogram Pattern

William J. Brady, MD

Case presentation: A 67-year-old male with a past history of coronary artery disease, diabetes mellitus, and hypertension presented to the emergency department with substernal chest pain. The pain had appeared

approximately 2 hours previously and was associated with diaphoresis and nausea. The patient was treated for acute cardiac ischemia. A 12-lead ECG was performed (shown here).



Question: Which of the following is the correct statement regarding the ECG presentation of left bundle branch block (LBBB) and possible acute myocardial infarction?

- A. LBBB pattern does not confound the clinician's ability to use the ECG to diagnose acute myocardial infarction
- B. Discordant ST segments are most often normal in the LBBB pattern

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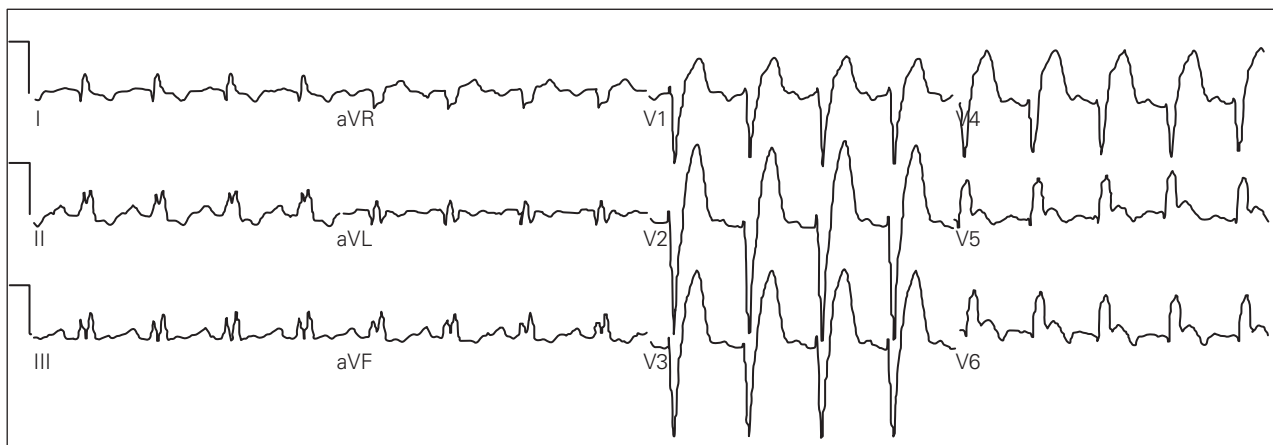


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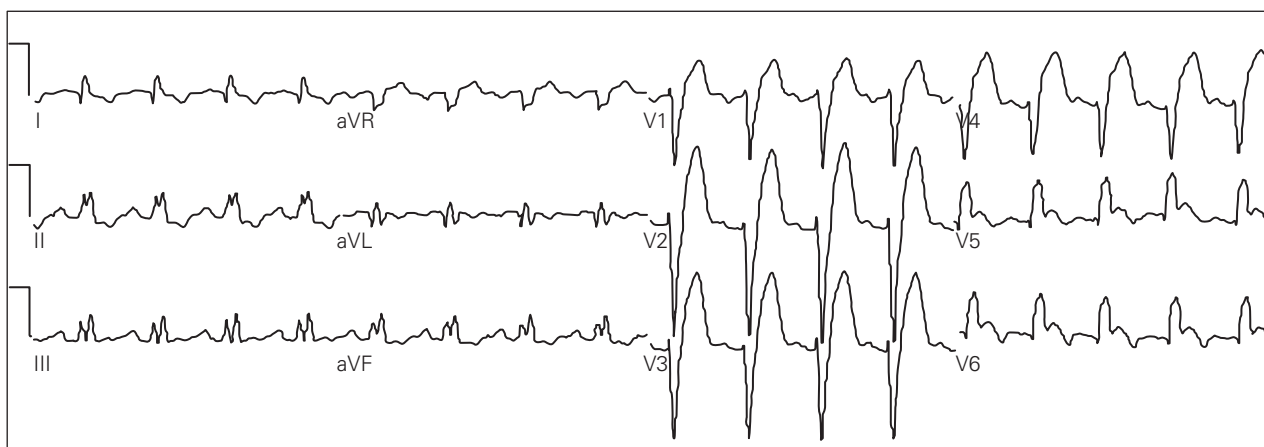


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- C. Concordant ST segment elevation is a normal finding in the LBBB pattern
 - D. LBBB pattern is not associated with an increased risk of poor outcome in patients with acute coronary syndrome
 - E. The longer the QRS duration, the greater the risk for acute coronary syndrome
- See page 149 for Answer, Diagnosis, and Discussion.

CASE 78 | Sudden Sedation in a Student

David T. Lawrence, DO

Case presentation: A 22-year-old female college student is dropped off by her friends in the triage area of the emergency department. The only history from the friends is that the patient would not wake up. The patient is lethargic, arousable only to painful stimuli, and has no obvious signs of trauma. The presenting vital signs are pulse 52 beats per minute, blood pressure 85/70 mmHg, respiration 8 breaths per minute and shallow, oxygen saturation 90% on room air, and temperature 36°C. The remainder of the patient's examination is unremarkable except for the eye examination and the examination of the skin under the axilla (see figures).



Question: Which of the following signs or symptoms would least likely be observed in a patient suspected of an acute opioid overdose?

- A. Respiratory depression
- B. Miosis
- C. Somnolence



- D. Hypothermia
- E. Agitation and hypertension

See page 150 for Answer, Diagnosis, and Discussion.

CASE 79 | Skin Lesions in a Comatose Patient

Christopher P. Holstege, MD and Matthew D. Wilson, MD

Case presentation: A 24-year-old male presents to the emergency department following an overdose of multiple pills, including sedatives. He was intubated at the scene by paramedics and transported to the hospital. On exami-

nation of the patient, the skin lesions pictured here are discovered.

A Foley catheter is placed, with return of the urine pictured in the figure.

- C. Concordant ST segment elevation is a normal finding in the LBBB pattern
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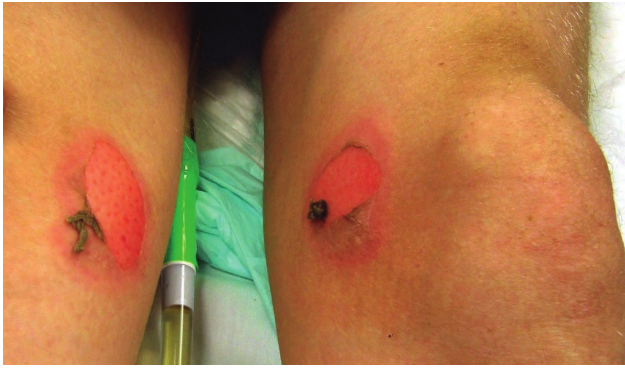
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A Foley catheter is placed, with return of the urine pictured in the figure.



Question: Which of the following is the most appropriate initial therapy?

- A. Apply silver sulfadiazine cream to the wounds
- B. Administer intravenous broad-spectrum antibiotics
- C. Administer adequate intravenous fluids to assure an adequate urine output
- D. Perform emergent fasciotomy in the emergency department
- E. Administer intravenous potassium

See page 151 for Answer, Diagnosis, and Discussion.



CASE 80 | Raccoon Eyes

Angela M. Mills, MD

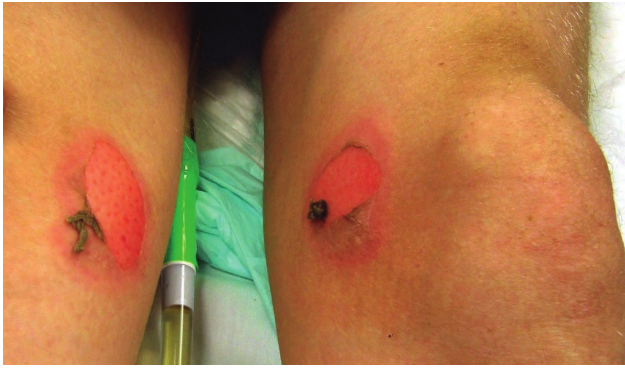
Case presentation: A 25-year-old male was involved in a motorcycle crash without a helmet. The patient had a documented loss of consciousness at the scene and presents with a complaint of head pain, dizziness, and nausea. On examination, the patient's appearance was noted as in the photograph. The neurologic examination was unremarkable except for mild confusion.

Question: What is the next most appropriate management strategy at this time?

- A. Recommend analgesics, ice, and follow-up care
- B. Emergent lateral canthotomy
- C. Order a skull radiograph
- D. Order a computed tomography of the head scan for possible intracranial injury
- E. Administer mannitol and dexamethasone emergently



See page 152 for Answer, Diagnosis, and Discussion.



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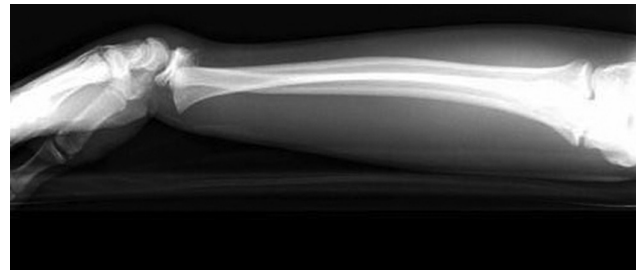


See page 152 for Answer, Diagnosis, and Discussion.

CASE 81 | Fall on an Outstretched Hand in a Young Adolescent

William Brady, MD and Kevin S. Barlotta, MD

Case presentation: A 13-year-old male presents to the emergency department with right wrist pain. He reports falling on his outstretched hands while running at full sprint during a soccer game. He noted immediate pain in his right wrist. On examination, he has tenderness in the region of the distal radius with overlying soft tissue swelling. Radiographs (pictured here) have been performed.



Question: The patient can expect the following outcome from this injury, assuming that adequate care is provided:

- A. Complete growth arrest with a shortened right arm length
- B. Complete recovery with normal growth
- C. Chronic pain with osteonecrosis at the injury site

- D. Chronic disability as a consequence of this injury
- E. High risk for the development of compartment syndrome

See page 153 for Answer, Diagnosis, and Discussion.

CASE 82 | Eye Pain and Facial Swelling

Adam K. Rowden, DO and Chris S. Bergstrom, MD

Case presentation: A 25-year-old, previously healthy female presents with a complaint of eye pain for 3 days. She denies associated fever or chills. She has no change in her vision. She denies nasal discharge or sinus pressure. She initially noted redness of her eyelid, which then progressively swelled and became more painful. Her physical examination (noted in the picture) reveals her eye lid and surrounding soft tissue to be warm and swollen. Her extraocular movements are intact, her visual acuity is normal, her pupillary reflex is intact, and her conjunctiva is noninflamed. Her vital signs are normal, and she is afebrile.



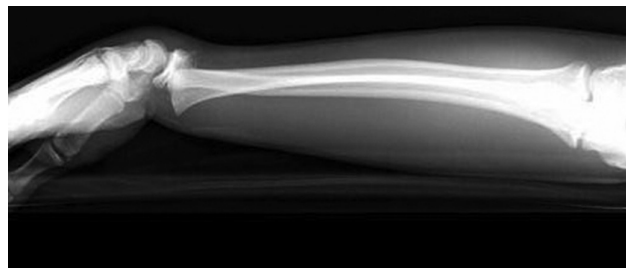
Question: Which of the following is the next correct step in her management?

- A. Administer oral antibiotics to cover *Staphylococcus aureus* and discharge her home with close outpatient follow-up with her primary care physician
- B. Administer intravenous antibiotics to cover *Haemophilus influenzae* and admit to the hospital

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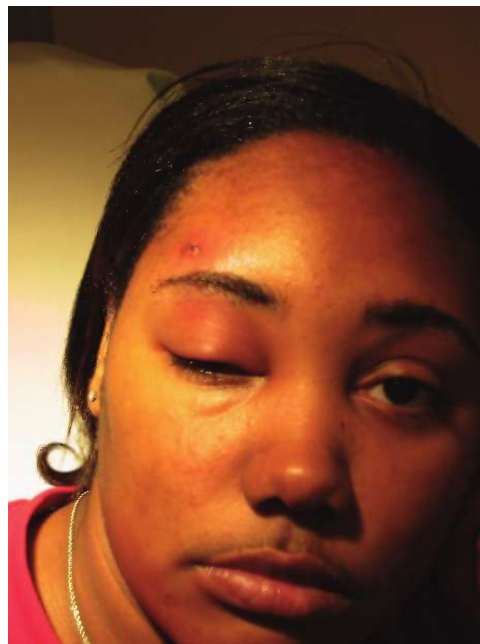
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- B. Administer intravenous antibiotics to cover *Haemophilus influenzae* and admit to the hospital

- C. Administer intravenous antibiotics to cover *H. influenzae* and *S. aureus* and obtain an enhanced orbital computed tomography scan
- D. Obtain an urgent ear–nose–throat consultation for debridement, and start intravenous antibiotics

- E. Initiate high-dose prednisone and send for an erythrocyte sedimentation rate while arranging rheumatology follow-up.

See page 154 for Answer, Diagnosis, and Discussion.

CASE 83 | Wrist Pain Following Fall on an Outstretched Hand

William J. Brady, MD and Kevin S. Barlotta, MD

Case presentation: A 28-year-old male patient presents to the emergency department after sustaining a fall on his outstretched hand (“FOOSH”). He noted immediate pain but denies other complaints. Examination reveals snuffbox tenderness. The radiograph pictured here was obtained.

Question: What is the appropriate course of management in this patient?

- A. Discharge home with nonsteroidal anti-inflammatory therapy and no scheduled outpatient physician follow-up
- B. Splint the wrist, prescribe appropriate analgesic therapy, and discharge home with instructions to leave the splint in place for 1 week, at which time the patient can resume normal activity
- C. Inform the patient that he may have an occult wrist fracture, splint the wrist, prescribe appropriate analgesic therapy, and arrange close physician outpatient follow-up
- D. Perform magnetic resonance imaging at the initial evaluation with emergent orthopedic surgery consultation
- E. Perform fracture reduction under conscious sedation and cast the wrist



See page 155 for Answer, Diagnosis, and Discussion.

CASE 84 | Rash on a Child with Epilepsy

Heather A. Borek, MD and Christopher P. Holstege, MD

Case presentation: A 3-year-old female with a history of epilepsy controlled by phenytoin presents to the emergency department with a rapidly progressing, painful rash, inability to swallow secretions, and difficulty breath-

ing. The rash began 5 days previously, at which time her mother noted mild skin tenderness, low grade fever, anorexia, and malaise. The child also complained of headache and developed diarrhea. She has been seen by three dif-

- C. Administer intravenous antibiotics to cover *H. influenzae* and *S. aureus* and obtain an enhanced orbital computed tomography scan
- D. Obtain an urgent ear–nose–throat consultation for debridement, and start intravenous antibiotics

- E. Initiate high-dose prednisone and send for an erythrocyte sedimentation rate while arranging rheumatology follow-up.

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Question: What is the appropriate course of management in this patient?

- A. Discharge home with nonsteroidal anti-inflammatory therapy and no scheduled outpatient physician follow-up
- B. Splint the wrist, prescribe appropriate analgesic therapy, and discharge home with instructions to leave the splint in place for 1 week, at which time the patient can resume normal activity
- C. Inform the patient that he may have an occult wrist fracture, splint the wrist, prescribe appropriate analgesic therapy, and arrange close physician outpatient follow-up
- D. Perform magnetic resonance imaging at the initial evaluation with emergent orthopedic surgery consultation
- E. Perform fracture reduction under conscious sedation and cast the wrist



See page 155 for Answer, Diagnosis, and Discussion.

CASE 84 | Rash on a Child with Epilepsy

Heather A. Borek, MD and Christopher P. Holstege, MD

Case presentation: A 3-year-old female with a history of epilepsy controlled by phenytoin presents to the emergency department with a rapidly progressing, painful rash, inability to swallow secretions, and difficulty breath-

ing. The rash began 5 days previously, at which time her mother noted mild skin tenderness, low grade fever, anorexia, and malaise. The child also complained of headache and developed diarrhea. She has been seen by three dif-

- C. Administer intravenous antibiotics to cover *H. influenzae* and *S. aureus* and obtain an enhanced orbital computed tomography scan
- D. Obtain an urgent ear–nose–throat consultation for debridement, and start intravenous antibiotics

- E. Initiate high-dose prednisone and send for an erythrocyte sedimentation rate while arranging rheumatology follow-up.

See page 154 for Answer, Diagnosis, and Discussion.

CASE 83 | Wrist Pain Following Fall on an Outstretched Hand

William J. Brady, MD and Kevin S. Barlotta, MD

Case presentation: A 28-year-old male patient presents to the emergency department after sustaining a fall on his outstretched hand (“FOOSH”). He noted immediate pain but denies other complaints. Examination reveals snuffbox tenderness. The radiograph pictured here was obtained.

Question: What is the appropriate course of management in this patient?

- A. Discharge home with nonsteroidal anti-inflammatory therapy and no scheduled outpatient physician follow-up
- B. Splint the wrist, prescribe appropriate analgesic therapy, and discharge home with instructions to leave the splint in place for 1 week, at which time the patient can resume normal activity
- C. Inform the patient that he may have an occult wrist fracture, splint the wrist, prescribe appropriate analgesic therapy, and arrange close physician outpatient follow-up
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ferent health care providers over the past 5 days, all of whom diagnosed her with a viral exanthem. When the child's mother awoke on the morning of arrival to the emergency department, she found her child with marked progression of the rash and diffuse mucous membrane involvement (illustrated). In the emergency department, her vital signs are blood pressure 67/34 mmHg, pulse 160 beats per minute, respiration 38 breaths per minute, and temperature 38.5°C. She is subsequently intubated. Her laboratory studies demonstrate both renal and hepatic dysfunction.

Question: Which of the following is correct regarding this child's condition?

- A. This child would be expected to have a positive Nikolsky's sign
- B. If this child had been started on antibiotics earlier, she likely would not have required intubation
- C. With proper treatment, this child's chances of survival are greater than 90%
- D. This is a primary dermatologic condition, with other organ involvement not expected
- E. She should be restarted on her phenytoin to avoid seizure complications

See page 157 for Answer, Diagnosis, and Discussion.



CASE 85 | Abdominal Pain in an Alcoholic

Angela M. Mills, MD

Case presentation: A 45-year-old male with a history of alcohol abuse presents to the emergency department with midepigastria abdominal pain radiating straight through to his back and associated with nausea and vomiting. His laboratory values are consistent with the diagnosis of acute pancreatitis. A plain film of the abdomen is obtained (illustrated).

Question: What is the name of this radiologic finding?

- A. Double bubble sign
- B. Target sign
- C. Sentinel loop
- D. String of pearls sign
- E. Coffee-bean sign

See page 158 for Answer, Diagnosis, and Discussion.



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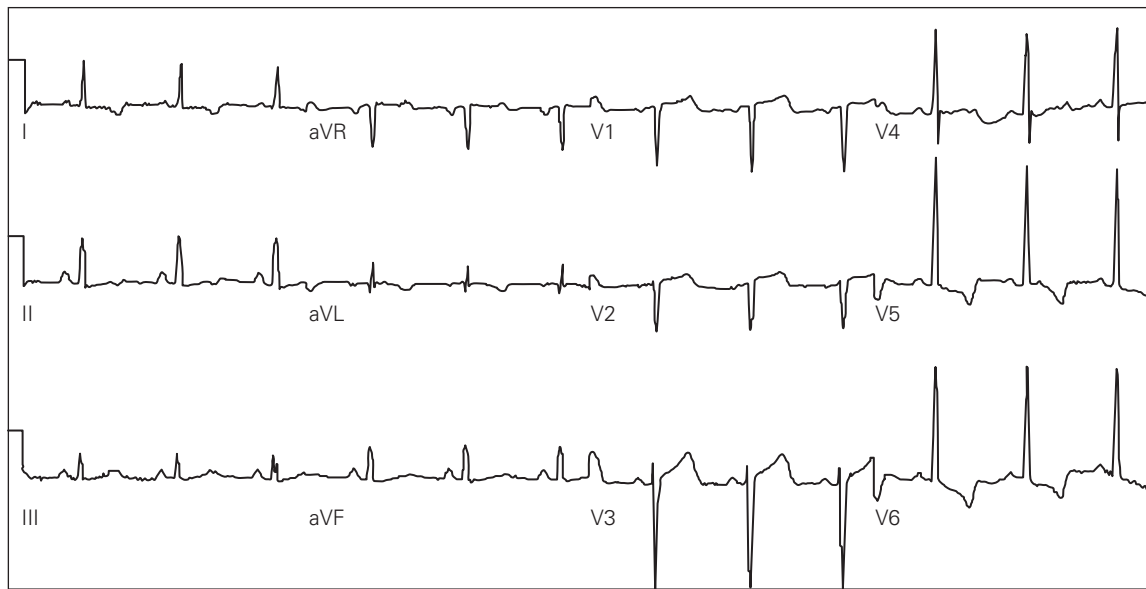


CASE 86 | Chest Pain with Electrocardiographic ST Segment and T Wave Abnormalities

William J. Brady, MD

Case presentation: A 55-year-old female with a history of hypertension presented to the emergency department with chest pain. The physical examination was unremarkable. The initial 12-lead ECG is noted in the figure. The

patient received nitroglycerin and aspirin, with resolution of the pain. Serial ECGs did not reveal interval change, and laboratory studies were negative. The patient ruled out for myocardial infarction.



Question: Electrocardiographic left ventricular hypertrophy:

- A. Confounds the electrocardiographic diagnosis of acute myocardial infarction
- B. Does not reduce the ECG's ability to diagnose acute coronary syndrome

- C. Is always associated with ST segment/T wave changes
- D. Is an indication for fibrinolysis
- E. Is always associated with hypertension

See page 159 for Answer, Diagnosis, and Discussion.

CASE 87 | A Heroin Abuser with Multiple Skin Lesions

Christopher P. Holstege, MD and Ashley L. Harvin, MD

Case presentation: A 42-year-old female with a history of hepatitis C presents to the emergency department with a complaint of left hand pain that she attributed to a "chronic skin condition." Examination of her hand was significant for the findings pictured here. Peripheral intravenous access was attempted without success. The patient

was discovered to have extensive scarring along her bilateral femoral and external jugular veins.

Question: Which of the following best describes her skin condition?

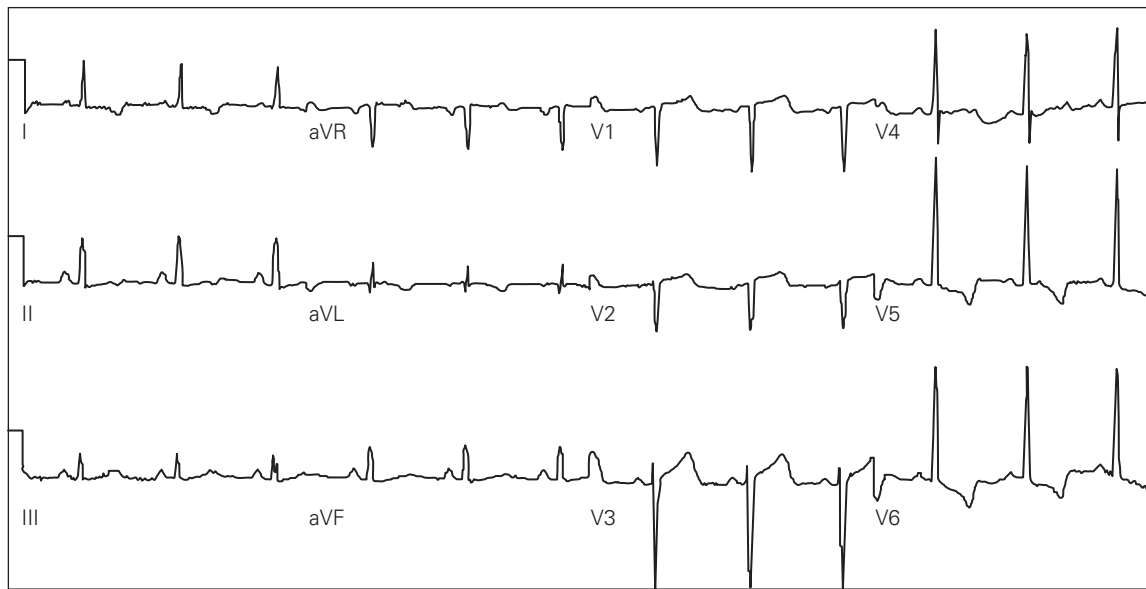
- A. "Grand central station"

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Question: Which of the following best describes her skin condition?

- A. "Grand central station"

- B. Skin popping
- C. Acne vulgaris
- D. Pocketing
- E. Acne cystica

See page 160 for Answer, Diagnosis, and Discussion.



CASE 88 | Chest Pain in a Middle-aged Male Patient with ST Segment Elevation

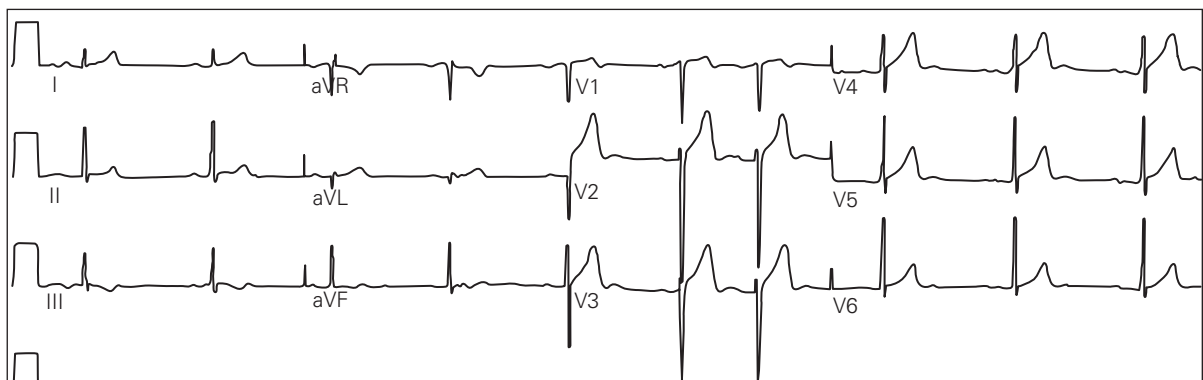
William J. Brady, MD

Case presentation: A 42-year-old male presents to the emergency department with chest pain. The examination revealed no distress with normal vital signs. A 12-lead ECG is noted below. The patient received appropriate medications while laboratory studies and chest radiograph were performed; the results of all such studies were within normal limits. Serial ECG did not demonstrate a change in the ST segment elevation or any further ST segment or T wave abnormality.

Question: The electrocardiographic pattern of benign early repolarization is:

- A. Most often seen in elderly patients
- B. Indicative of underlying cardiac pathology
- C. A noninfarction cause of ST segment elevation
- D. Associated with an increased risk of sudden cardiac death
- E. Associated with valvular heart disease

See page 161 for Answer, Diagnosis, and Discussion.



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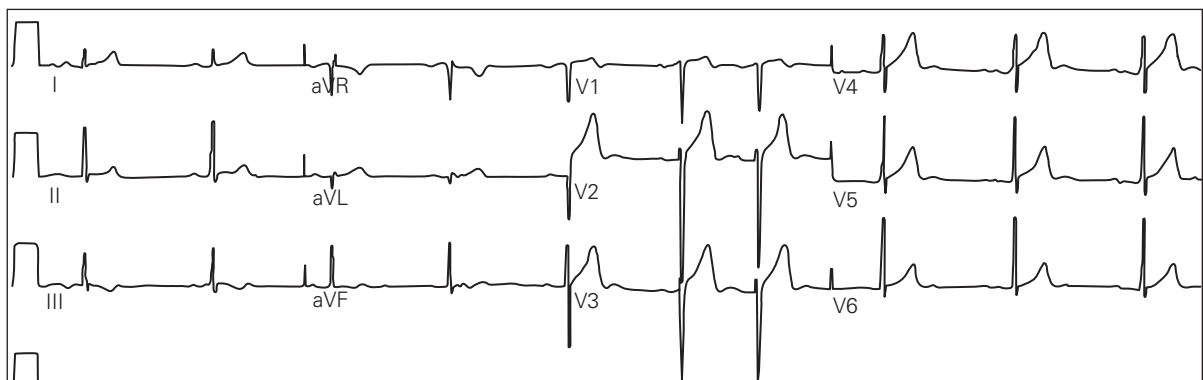
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See page 161 for Answer, Diagnosis, and Discussion.



CASE 89 | Fire Victim with Hoarseness

Kathryn Mutter, MD and Christopher P. Holstege, MD

Case presentation: A 78-year-old man arrives via ambulance with a severe burn after a house fire. He reports that he had been asleep when the fire broke out. He attempted to extinguish the fire with his blanket, but the fire flashed and resulted in extensive burns to his neck, face, arms, and legs. His facial examination is pictured here. He jumped from the second-story bedroom into the bushes below. He is complaining of pain at his burn sites and difficulty breathing. He is coughing up soot-filled sputum. His vital signs reveal pulse 124 beats per minute, blood pressure 98/54 mm Hg, respiration 38 breaths per minute, and temperature 37.1°C. He is oriented to person, place, and time. His right ankle has an obvious deformity. He has a hoarse voice, audible stridor and diffuse rales on lung examination, and 40% of his body surface area has second- and third-degree burns.



Question: The most important next step in his management includes which of the following?

- A. Administer intravenous fluids at a maintenance rate of 100 mL per hour
- B. Reduce his ankle and place a temporary splint
- C. Avoid administration of opioid analgesics to prevent sedation
- D. Initiate bilevel positive airway pressure to maximize the patient's oxygenation
- E. Emergent rapid sequence intubation

See page 162 for Answer, Diagnosis, and Discussion.

CASE 90 | A Gardener with a Non-healing Rash

Roger A. Band, MD and Steve Larson, MD

Case presentation: This 46-year-old gardener presented to a remote clinic in a Guatemalan village. He complained of nodular, erythematous lesions on his right upper extremity. The initial lesion on his distal arm eventually ulcerated, and other lesions have been draining nonpurulent material. The patient is otherwise without complaints and specifically denies nausea, vomiting, fevers, weight loss or diarrhea. On examination, he appears generally well, with the exception of the impressive lesions on his right upper extremity, seen in the pictures.

Question: What is the most likely cause for these lesions?

- A. Methicillin-resistant *Staphylococcus aureus*
- B. Scalding injury
- C. Scabies
- D. Sporotrichosis
- E. Tuberculosis

See page 163 for Answer, Diagnosis, and Discussion.

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CASE 91 | A Bite to the Leg in Tall Grass

Alejandro C. Stella, MD and Christopher P. Holstege, MD

Case presentation: A 22-year-old male presents to the emergency department with a complaint that a copper-head snake had bitten his leg 1 hour before. He denies any significant pain other than mild discomfort where the fangs broke the skin. He has no nausea or vomiting. The examination of the envenomation site is noted below, with the fang puncture wounds circled. He has no tenderness on palpation of his leg, and his leg compartments are soft. He ambulates without difficulty and demonstrates full range of motion of his leg.

Question: Which of the following would be appropriate in his management?

- A. Emergent antivenom administration
- B. Immediate application of a suction device
- C. Tourniquet application to his leg
- D. Discharge to home if there is no further development of symptoms over the next 4 hours
- E. Incise the bite site and irrigate the wound



See page 164 for Answer, Diagnosis, and Discussion.



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See page 164 for Answer, Diagnosis, and Discussion.

CASE 92 | An Elderly Man with Diffuse Facial Edema

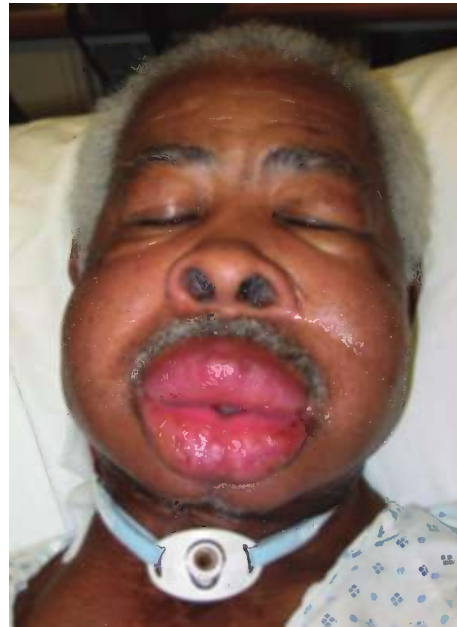
Kevin S. Barlotta, MD and Alexander B. Baer, MD

Case presentation: A 63-year-old male with a history of neck cancer and subsequent tracheostomy presents with a complaint of facial “fullness” that rapidly developed over the previous 24 hours. For the past week, he has noted mild facial swelling in the morning, but it has rapidly resolved as the day progressed. He denies trauma, fever, or dental discomfort. He is taking no new medications and is not on any angiotensin-converting enzyme inhibitors. His facial examination is pictured.

Question: What is the most likely clinical diagnosis?

- A. Angioedema
- B. Ludwig’s angina
- C. Bullous pemphigoid
- D. Superior vena cava syndrome
- E. Stevens–Johnson syndrome

See page 165 for Answer, Diagnosis, and Discussion.



CASE 93 | Acute-onset Double Vision

Chris S. Bergstrom, MD and Alexander B. Baer, MD

Case presentation: A 47-year-old female presents to the emergency department with a complaint of acute retrobulbar pain and left lid droop. She also states that when she holds her eyelid open, she has double vision. Her past medical and ocular history is negative for hypertension and diabetes. She takes no medications. Physical examination reveals a complete ptosis of the left upper lid as noted in the photograph.

Manually lifting the eyelid reveals the left eye with an outward deviation. The evaluation pictured here of the extraocular muscles shows a marked reduction in adduction and elevation, and depression of the left globe.

Visual acuity is 20/20 in each eye. Pupillary testing shows marked anisocoria, with the right pupil 3mm and the left pupil 8mm. The left pupil does not constrict to light stimulation. The remaining ocular and neurologic examination is normal.



Question: What is the most likely cause of this patient’s physical examination findings?

- A. Bell’s palsy
- B. Fourth cranial nerve palsy
- C. Third cranial nerve palsy
- D. Benign strabismus of childhood
- E. Fifth cranial nerve palsy

See page 166 for Answer, Diagnosis, and Discussion.

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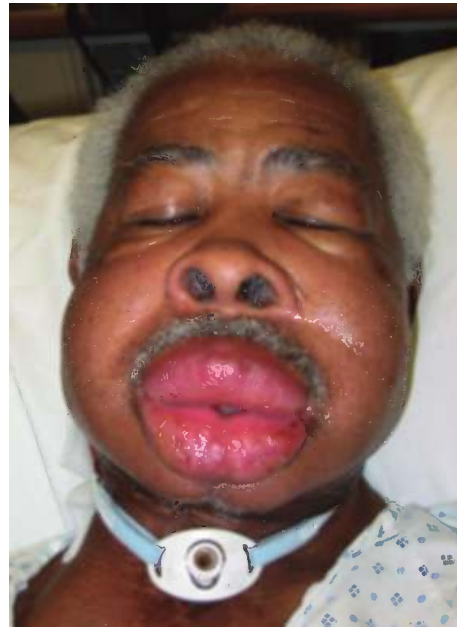
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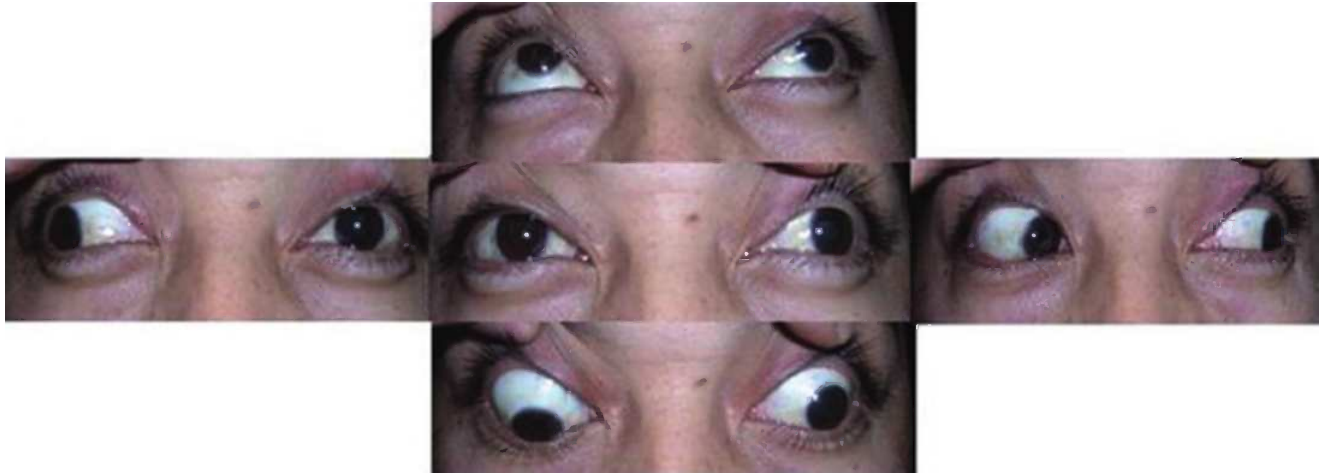
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CASE 94 | Low Back Pain in a Car Accident Victim

Edward G. Walsh, MD and William J. Brady, MD

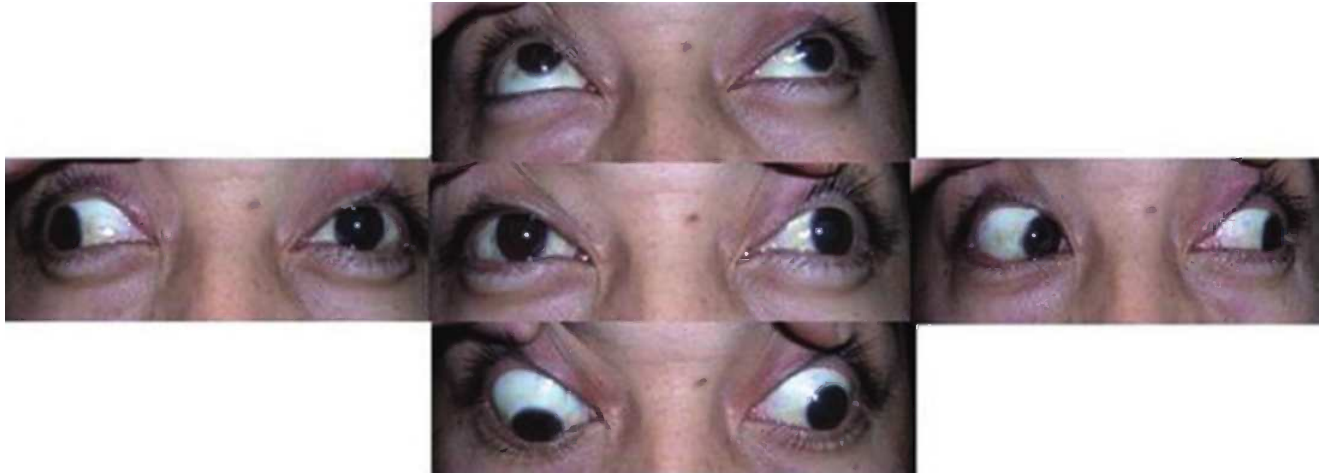
Case presentation: A 48-year-old female was the restrained rear seat passenger in a high-speed motor vehicle crash. The car was traveling approximately 70 miles per hour and hit an oncoming truck that had crossed the median. There was extensive damage to the vehicle, and an on-scene fatality was reported by paramedics. During her prolonged extrication, the patient complained of immediate lower back pain and lower extremity paresthesia. She was immobilized on scene and transported to the emergency department. Upon arrival, the patient complained of severe lower back pain and bilateral lower extremity paresthesia. She had a notable “seat-belt sign” across her lower abdomen. Her neurologic examination was significant for decreased sensation in both lower extremities and decreased dorsiflexion in both feet. A full trauma evaluation was initiated, and multiple radiographs including those shown here were obtained.



Question: This presentation is consistent with which type of injury?

- A. T12–L1 dislocation
- B. L5 tear drop fracture
- C. L1 transverse process fracture
- D. L2 pedicle fracture
- E. L3 burst fracture

See page 167 for Answer, Diagnosis, and Discussion.



CASE 94 | Low Back Pain in a Car Accident Victim

Edward G. Walsh, MD and William J. Brady, MD

Case presentation: A 48-year-old female was the restrained rear seat passenger in a high-speed motor vehicle crash. The car was traveling approximately 70 miles per hour and hit an oncoming truck that had crossed the median. There was extensive damage to the vehicle, and an on-scene fatality was reported by paramedics. During her prolonged extrication, the patient complained of immediate lower back pain and lower extremity paresthesia. She was immobilized on scene and transported to the emergency department. Upon arrival, the patient complained of severe lower back pain and bilateral lower extremity paresthesia. She had a notable “seat-belt sign” across her lower abdomen. Her neurologic examination was significant for decreased sensation in both lower extremities and decreased dorsiflexion in both feet. A full trauma evaluation was initiated, and multiple radiographs including those shown here were obtained.



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See page 167 for Answer, Diagnosis, and Discussion.

CASE 95 | Pain and Rash Following Contact with a Caterpillar

Nathan P. Charlton, MD and Mairin Smith, MD

Case presentation: A patient presented to an urgent care facility 15 minutes after contact with the organism depicted here.

The patient described throbbing pain at the site but denied generalized pruritus, edema, fever, chills, and difficulty breathing. All vital signs were normal. Clinical examination revealed wheals surrounded by an erythematous macular halo (see illustration).



Question: Which of the following is the next most appropriate management?

- A. Subcutaneous epinephrine (adrenaline)
- B. Antivenom
- C. Hyperbaric oxygen
- D. Topical corticosteroids
- E. Prednisone

See page 167 for Answer, Diagnosis, and Discussion.

CASE 96 | Moonshine-induced Basal Ganglion Necrosis and Metabolic Acidosis

Nathan P. Charlton, MD and Christopher P. Holstege, MD

Case presentation: A 57-year-old alcoholic female presented to the emergency department with marked sedation (withdrawal to pain, no eye opening, rare moaning). She had last been seen 18 hours previously, appearing inebriated. Her triage vital signs showed pulse 53 beats per minute, respiration 16 breaths per minute, blood pressure 156/75 mmHg, and rectal temperature 33.9°C. Her initial arterial blood gas on a nonrebreather showed: pH 6.78; P_{aCO_2} 12 mmHg; P_{aO_2}

334 mmHg; and HCO_3^- 1.7 mEq/L. A computed tomography scan of her brain was emergently obtained and is seen here.

Question: Which of the following alcohols is most likely responsible?

- A. Methanol
- B. Ethylene glycol
- C. Acetone

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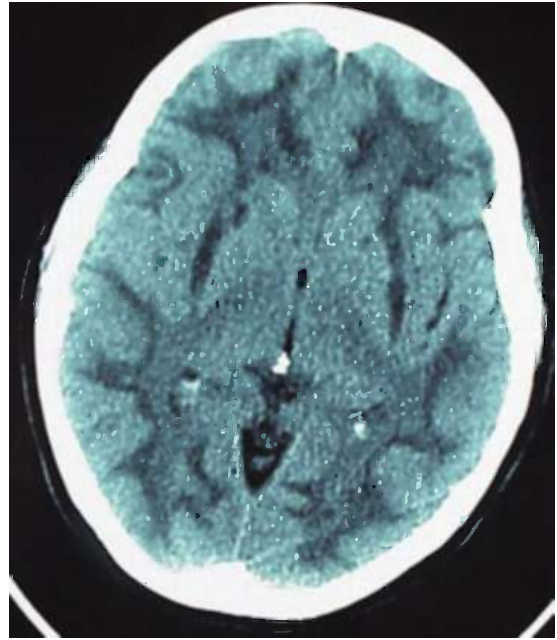
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Question: Which of the following alcohols is most likely responsible?

- A. Methanol
- B. Ethylene glycol
- C. Acetone

- D. Isopropyl alcohol
- E. Ethanol

See page 168 for Answer, Diagnosis, and Discussion.



CASE 97 | A Rock Climber with Finger Pain, Swelling, and Redness

Joseph D. Forrester, MD and Christopher P. Holstege, MD

Case presentation: A 25-year-old male spent several days on a climbing trip. The climber experienced significant abrasions to his hands as well as numerous tears of the skin on his fingers. Two days after completing the trip, he noticed increasing pain on his lateral aspect of his right first digit. He soaked this digit in warm saltwater, but over the course of several days the reddening and swelling increased. By the sixth day after returning from the climb, the climber reported that he was able to express pus from the area. Similar areas of redness also developed on the cuticles of his left first digit. The climber presented to emergency department 10 days after the redness first appeared with the skin findings illustrated here.

Question: What is the name of this infection?

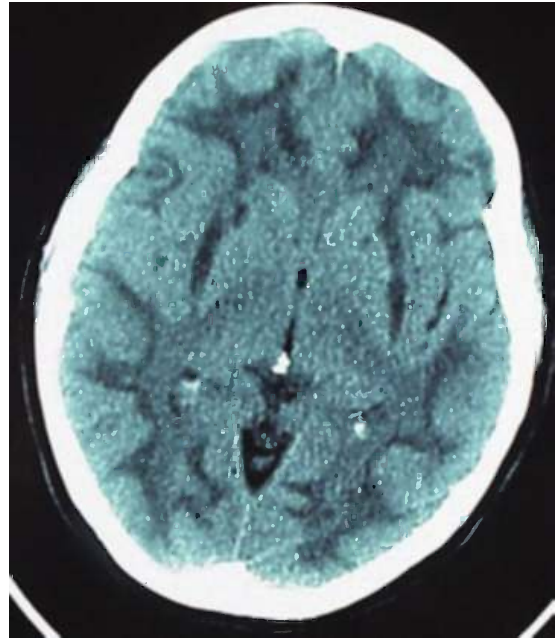
- A. Paronychia
- B. Whitlow
- C. Felon
- D. Onycholysis
- E. Pemphigus vulgaris



See page 169 for Answer, Diagnosis, and Discussion.

- D. Isopropyl alcohol
- E. Ethanol

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- B. Whitlow
- C. Felon
- D. Onycholysis
- E. Pemphigus vulgaris



See page 169 for Answer, Diagnosis, and Discussion.

CASE 98 | Vomiting and Syncope Following Ingestion of Ramps

Christopher P. Holstege, MD and Justin H. Price, MD

Case presentation: A 26-year-old male was foraging for ramps (*Allium tricocca*) while hiking in the George Washington National Forest in Virginia and picked a striated broad-leafed plant (pictured) for addition to his spaghetti later in the evening. While consuming his dinner, he noticed a tingling sensation along his tongue and developed a sensation that his “throat was closing up.” He stopped eating the meal “after four bites” and spontaneously vomited within a half hour of the meal. The patient was transported via emergency medical services to the emergency department due to intractable vomiting and dizziness. He complained of tongue and extremity paresthesias. His initial blood pressure was 83/42 mmHg, his pulse 42 beats per minute, and his respiration rate 20 breaths per minute. His examination was significant for anxiety (he stated he thought he was going to “die”), diaphoresis, and mild diffuse abdominal tenderness. His initial ECG was significant only for sinus bradycardia at a rate of 40 beats per minute, PR duration 188 milliseconds, QRS duration 87 milliseconds, and QTc duration 367 milliseconds. A leaf saved from the plant ingested (shown here) was brought to the hospital for identification.



Question: What plant was responsible for his toxicity?

- A. *Digitalis purpurea* (foxglove)
- B. *Convallaria majalis* (lily of the valley)
- C. *Nerium oleander* (oleander)
- D. *Conium maculatum* (poison hemlock)
- E. *Veratrum viride* (false hellebore)

See page 170 for Answer, Diagnosis, and Discussion.

CASE 99 | Chest Pain and Subtle ST Segment Elevation

William J. Brady, MD

Case presentation: A 46-year-old male presents to the emergency department with chest pain of 2 hours' duration; the pain is accompanied by nausea and diaphoresis. The patient appears pale and diaphoretic; otherwise, the examination is unremarkable. His ECG is noted here. The serum troponin was elevated, confirming the diagnosis of acute myocardial infarction (AMI). He was transferred to the catheterization laboratory for percutaneous coronary intervention. The patient had an uneventful hospital course.

Question: Choose the incorrect statement regarding reciprocal ST segment depression:

- A. Reciprocal ST segment depression is associated with an increased chance of poor outcome in ST elevation myocardial infarction (STEMI)
- B. Reciprocal ST segment depression increases the probability that ST segment elevation results from AMI
- C. Reciprocal ST segment depression is defined as ST segment depression occurring in the STEMI patient

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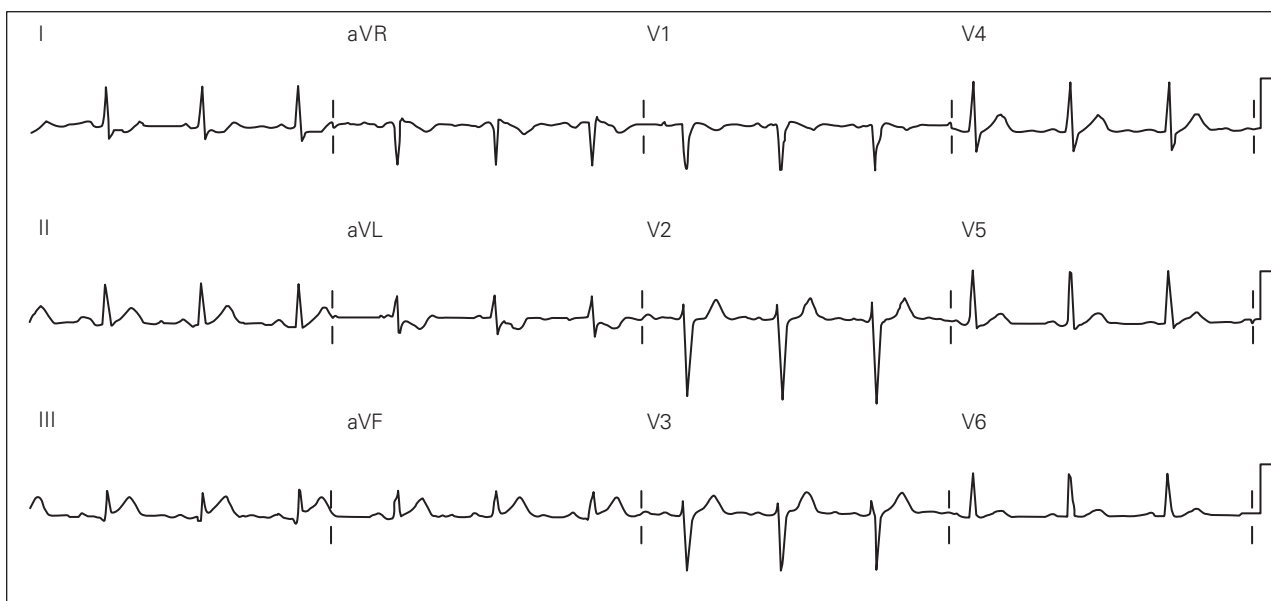
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- B. Reciprocal ST segment depression increases the probability that ST segment elevation results from AMI
- C. Reciprocal ST segment depression is defined as ST segment depression occurring in the STEMI patient



D. Reciprocal ST segment depression includes the ST segment depression encountered in patients with confounding patterns such as left bundle branch block

E. Reciprocal ST segment depression confers an improved prognosis

See page 171 for Answer, Diagnosis, and Discussion.

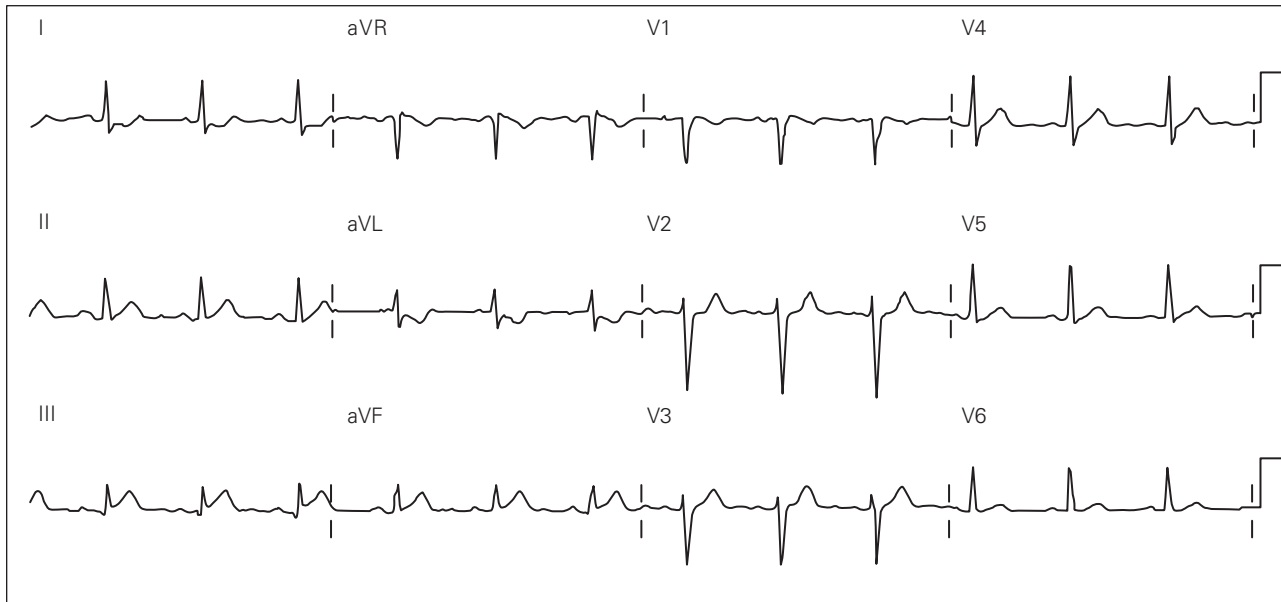
CASE 100 | Herbalist with Bradycardia and Vision Changes

William J. Brady, MD

Case presentation: A 33-year-old female herbalist presents to the emergency department with a complaint of weakness and yellow discoloration of her vision. She recently grew the plant pictured here and was ingesting it as an herbal remedy in an attempt to alleviate menstrual cramps.

On arrival, the patient is alert and oriented. Her initial vital signs are blood pressure 110/60mmHg, pulse 88 beats per minute, and respiration 28 breaths per minute. The rest of her examination is unremarkable. An initial 12-lead ECG demonstrates a normal sinus rhythm with multiple premature ventricular contractions. Her electrolyte results return from the laboratory demonstrating marked hyperkalemia. She subsequently develops progressive bradycardia (see the rhythm strip) over the ensuing 60 minutes.





D. Reciprocal ST segment depression includes the ST segment depression encountered in patients with confounding patterns such as left bundle branch block

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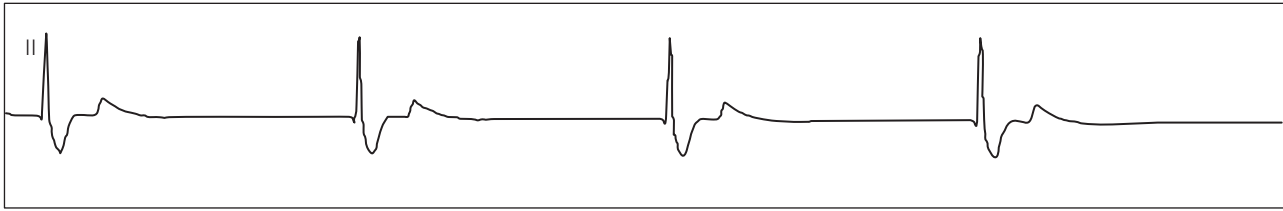
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Question: Which of the following would be appropriate in the management of this patient?

- A. Digoxin-specific Fab fragments
- B. Physostigmine
- C. Naloxone

- D. Flumazenil
- E. Amiodarone

See page 172 for Answer, Diagnosis, and Discussion.

CASE 101 | Painless Penile Ulcer

Andrea L. Neimann, MD

Case presentation: A 35-year-old male presents to the emergency department complaining of a “sore” that he recently noticed on his penis. He describes the “sore” as painless and he denies any associated penile discharge. He has never had this problem before. He is currently in a “stable” relationship with a man and recently had an HIV test that was negative. On examination, there is a single ulcer on the distal end of the penis. The ulcer is 2cm in diameter and has a slightly raised indurated margin with a clean base. His inguinal lymph nodes are mildly enlarged bilaterally. They feel slightly rubbery, but are discrete and nontender.



Question: What is the next most appropriate management strategy at this time?

- A. Discharge the patient to home without treatment
- B. Treat the patient empirically for herpes
- C. Be reassured by the patient’s reported negative HIV test result and suggest no further testing for HIV in the future
- D. Treat empirically for syphilis based on the history, physical examination, and knowledge of the

epidemiology of genital ulcers in your geographic area

- E. Perform urinalysis and treat based on the results

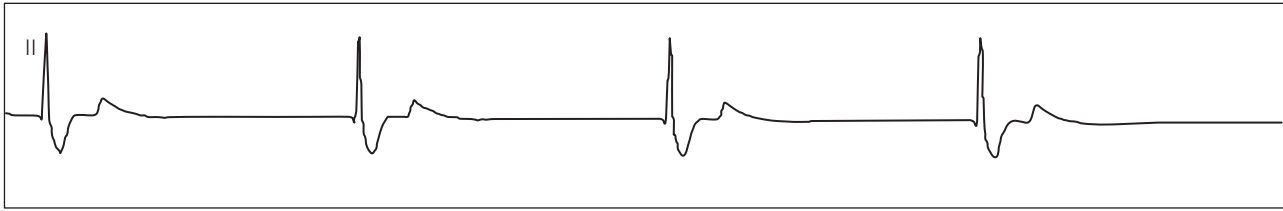
See page 172 for Answer, Diagnosis, and Discussion.

CASE 102 | Hyperthermia, Autonomic Instability, and Confusion in a Traveler

Christopher P. Holstege, MD and Alexander B. Baer, MD

Case presentation: An 18-year-old South American male was traveling from Miami to New York City by

Amtrak train. While at a train station along the way, he was noted by the conductor to be acting oddly and the



Question: Which of the following would be appropriate in the management of this patient?

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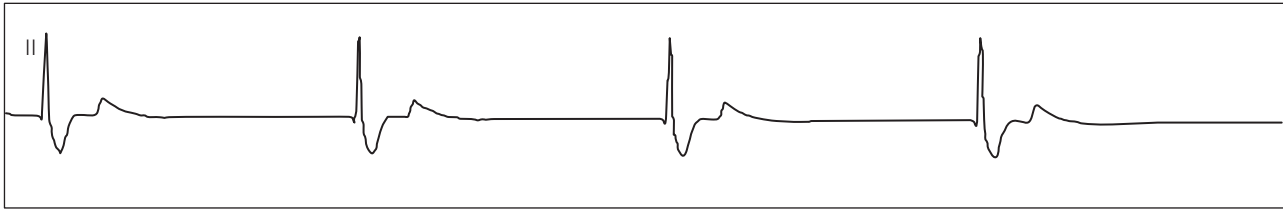
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Amtrak train. While at a train station along the way, he was noted by the conductor to be acting oddly and the

police were called. On search of his possessions, the packets pictured here were discovered.

He was subsequently transported by paramedics with police escort to the emergency department. His initial vital signs on presentation are as follows: blood pressure 195/113mmHg, pulse 143 beats per minute, respiration 36 breaths per minute, and temperature 38.7°C. His examination is significant for confusion, agitation, mydriasis, diaphoresis, and tremor. A radiograph of his abdomen is noted here.



Question: Which of the following would be indicated in his management?

- A. Propranolol
- B. Lorazepam
- C. Sotalol
- D. Procainamide
- E. Gastric lavage

See page 173 for Answer, Diagnosis, and Discussion.

CASE 103 | An Immigrant with Neck Swelling

Suzanne M. Shepherd, MD and William H. Shoff, MD

Case presentation: A 45-year-old male immigrant from Morocco presents with neck discomfort and swelling. Three months previously, this area of his neck was initially swollen with only a single mass noted. Over the last month, the area began to drain and he has noted an increase in the number of masses. He also has had an unexpected 30 pound weight loss over the last year, with associated night sweats. He denies any other illnesses. He lives alone and is employed as a taxi driver.

His examination is unremarkable except for the neck examination depicted here. There are also multiple 2–6 cm, matted, soft, and in one case fluctuant, mildly tender masses along the posterior cervical chain.



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His examination is unremarkable except for the neck examination depicted here. There are also multiple 2–6 cm, matted, soft, and in one case fluctuant, mildly tender masses along the posterior cervical chain.



Question: Which of the following illnesses would be the most likely cause of this patient's illness?

- A. Mononucleosis
- B. Streptococcal pharyngitis
- C. Cytomegalovirus

- D. Tuberculosis
- E. Toxoplasmosis

See page 174 for Answer, Diagnosis, and Discussion.

CASE 104 | Eyelid Laceration Following a Brawl

Chris S. Bergstrom, MD and Alexander B. Baer, MD

Case presentation: A 35-year-old male is seen in the emergency department after a bar fight. He has several facial lacerations from a broken bottle. He is complaining of mild periorbital pain and epiphora. On physical examination, his visual acuity is 20/30 in the left eye. His pupils are equally round and responsive to direct and consensual stimulation. There is a superficial laceration of the upper lid that does not involve the lid margin and is without evidence of prolapsed orbital fat. The lower lid has two full-thickness lacerations through the lid margin, one of which is medial to the lower punctum. The conjunctiva, sclera, and cornea are normal. The anterior chamber is deep and clear. The iris is normal and the pupil is round.



Question: Periorbital laceration with prolapsed orbital fat implies damage to what structure?

- A. Optic nerve
- B. Lacrimal drainage system
- C. Cornea

- D. Orbital septum
- E. Anterior maxillary wall

See page 176 for Answer, Diagnosis, and Discussion.

CASE 105 | Young Athlete with Back Pain

Edward G. Walsh, MD and William J. Brady, MD

Case presentation: A 20-year-old man returns to the emergency department with a chief complaint of lower back pain. He has been seen twice previously for the same complaint. There is no history of trauma or overuse. He plays tennis regularly and runs 3–5 miles nearly every day of the week. He has been unable to exercise regularly since his symptoms began 3 months ago. He has noted some bilateral hamstring tightness but no other symptoms or neurologic deficits. His physical examination is

benign except for tenderness and mild bilateral paraspinal muscle spasm over L5. His pain noticeably worsens on extension of his lower spine. The radiograph shown here has been obtained.

Question: This clinical presentation is most consistent with:

- A: L5 discitis
- B: Juvenile rheumatoid arthritis

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- C: Sciatica
- D: L5 pars defect
- E: Transverse myelitis

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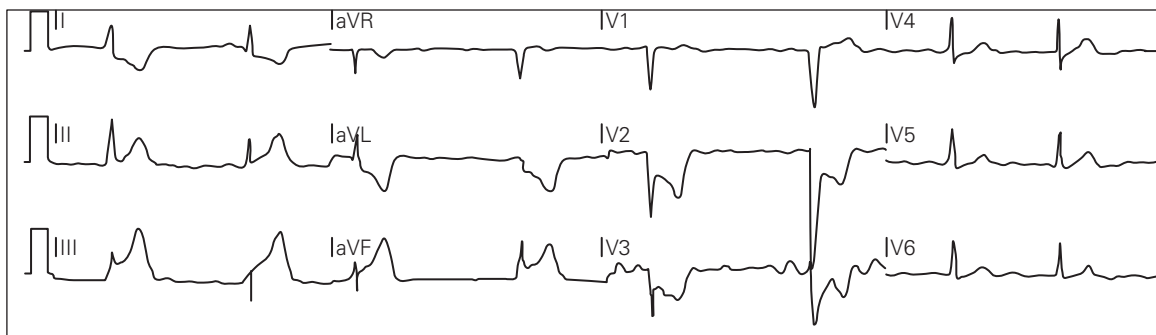


CASE 106 | Chest Pain and Hypotension in an Adult Male Patient

William J. Brady, MD

Case presentation: A 48-year-old man with a history of diabetes mellitus complained of substernal chest pain. On arrival to the emergency department he was pale, diaphoretic, and hypotensive with a blood pressure of 70mmHg by palpation; the pulmonary examination was

unremarkable. An ECG was performed and is shown here. Fluid resuscitation was initiated which corrected the hypoperfusion. Laboratory studies and a chest radiograph were obtained while appropriate medications were administered.



Question: The ECG reveals:

- A. Sinus bradycardia with nonspecific ST segment/T wave abnormalities
- B. Sinus bradycardia with inferoposterior acute myocardial infarction
- C. Sinus bradycardia with right ventricular acute myocardial infarction
- D. Sinus bradycardia with benign early repolarization
- E. Sinus bradycardia with anterior myocardial infarction

See page 177 for Answer, Diagnosis, and Discussion.

- C: Sciatica
- D: L5 pars defect
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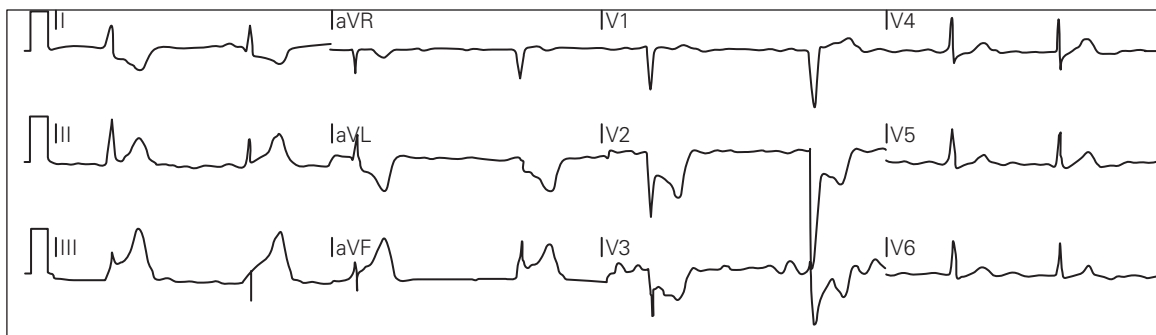


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- E. Sinus bradycardia with anterior myocardial infarction

See page 177 for Answer, Diagnosis, and Discussion.

CASE 107 | Adult Male with Atraumatic Lower Back Pain and Leg Weakness

William J. Brady, MD

Case presentation: A 46-year-old male presented to the emergency department with lower back pain of 3 days' duration. The patient denied trauma but noted previous back pain with a radicular distribution in the right lower extremity. The patient noted the recurrence of this pain with the onset of weakness in the legs. On examination, lower extremity weakness was noted in a symmetric fashion, reduced sensation was found in the perineum, and the rectal examination demonstrated diminished tone. A postvoid residual revealed 500 mL of urine remaining in the bladder. Plain film radiographs were performed and demonstrated minimal degenerative change. Magnetic resonance imaging of the lower spine (illustrated here) was performed.

Question: What is the likely neurologic outcome of this clinical entity if appropriate medical care is offered immediately?

- A. Complete loss of motor and sensory function in the lower extremities
- B. Complete normalization of bowel and bladder function
- C. Normalization of motor function with progression of bladder dysfunction
- D. Stabilization of the current neurologic status without worsening
- E. Paraplegia

See page 179 for Answer, Diagnosis, and Discussion.



CASE 108 | Facial Swelling in a Patient with Poor Dentition

Alexander B. Baer, MD and Christopher P. Holstege, MD

Case presentation: A 35-year-old male presents to the emergency department with a complaint of facial discomfort. He has developed progressive left molar odontalgia over the preceding week. Over the past 2 days, he has been having intermittent fevers and chills. Facial swelling (pictured here) began 4 hours prior to arrival. He denies having any dysphagia, dysphonia, or dyspnea.

Question: What would be the most appropriate management of this patient?

- A. Oral penicillin, opioid analgesics, and outpatient follow-up with his dentist
- B. Subcutaneous epinephrine, intravenous methylprednisolone, and diphenhydramine with admission to a monitored medical floor

CASE 107 | Adult Male with Atraumatic Lower Back Pain and Leg Weakness

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Question: What would be the most appropriate management of this patient?

- A. Oral penicillin, opioid analgesics, and outpatient follow-up with his dentist
- B. Subcutaneous epinephrine, intravenous methylprednisolone, and diphenhydramine with admission to a monitored medical floor



- C. Emergent ultrasound evaluation of the superior vena cava
- D. Intravenous broad-spectrum antibiotics and emergent neck surgery consultation

- E. Dental alveolar block with lidocaine and outpatient follow-up with dentistry

See page 180 for Answer, Diagnosis, and Discussion.

CASE 109 | Weakness and Bradycardia in an Elderly Female Patient

William J. Brady, MD

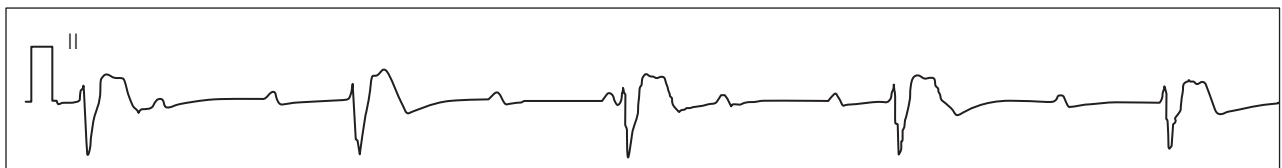
Case presentation: A 78-year-old woman with a history of coronary artery disease has experienced progressive weakness associated with chest pain. On arrival in the emergency department, the patient was without distress. The vital signs were significant only for bradycardia with a rate of 55 beats per minute. The 12-lead ECG demonstrated sinus bradycardia at a rate of 62 beats per minute with inferior ST segment depression; a bedside qualitative test was positive for troponin. The patient was diagnosed with a non-ST elevation myocardial infarction while appropriate therapy was initiated. Approximately 45 minutes after arrival, the patient developed hypotension with profound weakness and recurrent chest pain.

Her blood pressure is 85 mmHg by palpation and her pulse approximately 25 beats per minute. The ECG monitor demonstrates the rhythm shown here.

Question: The most frequent etiology of this type of rhythm is:

- A. Acute myocardial infarction
- B. Cardiotoxic medication ingestion
- C. Acute myocarditis
- D. Primary conduction system disease
- E. Pericarditis

See page 180 for Answer, Diagnosis, and Discussion.





- C. Emergent ultrasound evaluation of the superior vena cava
- D. Intravenous broad-spectrum antibiotics and emergent neck surgery consultation

- E. Dental alveolar block with lidocaine and outpatient follow-up with dentistry

See page 180 for Answer, Diagnosis, and Discussion.

CASE 109 | Weakness and Bradycardia in an Elderly Female Patient

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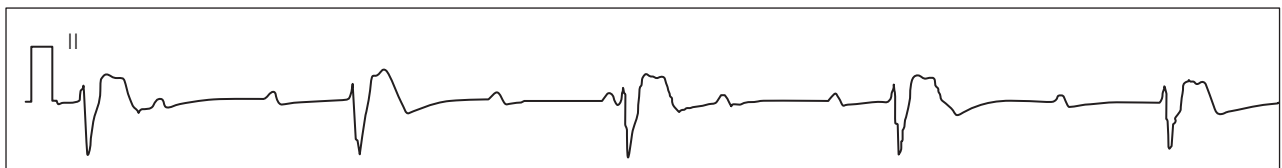
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- E. Pericarditis

See page 180 for Answer, Diagnosis, and Discussion.



CASE 110 | Lightning Strike Induced Skin Changes

Christopher P. Holstege, MD

Case presentation: A 21-year-old man was lying naked in a sleeping bag in his tent on the Appalachian Trail in Virginia when a massive thunderstorm entered the region. He was “jolted” following a nearby lightning strike and had immediate pain in his shoulder. He presented to the emergency department with the skin findings noted in the photograph here.

Question: What is the name of this skin finding that is pathognomonic for a lightning strike?

- A. Kissing
- B. Jellyfish
- C. Feathering
- D. Satellite
- E. Treeing

See page 181 for Answer, Diagnosis, and Discussion.



Part II

Answers, Diagnoses, and Discussion

CASE 1 | Slash Wound to the Neck

Answer: B

Diagnosis: Zone II neck injury

Discussion: To properly describe a penetrating injury to the neck, it is essential to note the zone of injury, the mechanism of injury, and whether the platysma muscle is violated. Division of the neck into three zones provides clinicians with important anatomic and management information. Zone I (base of the neck) extends from the sternal notch and clavicles to the cricoid cartilage. Zone II (mid-neck) comprises the area between the cricoid cartilage and the angle of the mandible. Zone III (upper neck) spans the distance between the angle of the mandible and the base of the skull. The platysma muscle is located between the superficial and deep cervical fascia of the neck. Violation of the platysma muscle should prompt a clinician to suspect injury to the vital structures of the neck.

The treatment of penetrating neck injuries continues to be debated in the surgical literature. Expectant management was the rule prior to the Second World War, and mortality rates were an abysmal 18–35%. In an effort to improve survival, a mandatory surgical approach was initiated, dropping mortality rates to 6%. This management approach remained the standard of care for decades. However, increases in the prevalence of negative neck explorations gave rise to the concept of selective surgical management. Selective surgical management aims to reduce the negative neck exploration rate while preserving a low mortality rate for penetrating neck trauma. Under the management scheme of selective surgical exploration, zone I and III injuries are initially imaged to clearly define a patient's vascular anatomy.

Angiography remains the gold standard for diagnosing vascular injuries. The desire for preoperative imaging stems from the tendency of zone I injuries to remain clinically concealed and the difficulty associated with surgically approaching zone III injuries. In contrast, the anatomy of the neck in zone II is easily approached and explored. Currently, most surgeons choose to surgically explore zone II injuries without preoperative imaging.

Although the necessity of surgical neck exploration and the reliability of physical examination continue to be

debated, serial examinations remain an essential part of the evaluation of a patient with a penetrating neck injury. While unstable patients require immediate airway management (with cervical spine immobilization) and more immediate surgical intervention, stable patients necessitate serial examinations for “soft” and “hard” signs of penetrating neck trauma. Hard signs include expanding hematoma, severe active bleeding, shock not responsive to fluids, decreased or absent radial pulse, vascular bruit or thrill, cerebral ischemia, and airway obstruction. Patients that develop hard signs will likely require surgical intervention. Soft signs include hemoptysis, hemothorax, dyspnea, dysphonia, dysphagia, subcutaneous or mediastinal air, nonexpanding hematoma, and the presence of focal neurologic deficits.

Patients who are in profound shock or who have uncontrollable hemorrhage from a penetrating neck injury should go directly to the operating room for hemorrhage control. Definitive airway management, large-bore intravenous access, and blood samples sent for crossmatch are essential in the immediate encounter, and depending on the level of hemorrhage, uncross-matched blood should be a consideration. Bedside vessel ligation can result in significant neurologic impairment and is not the treatment of choice. Temporary hemorrhage control with direct pressure can be utilized prior to transport to the operating room. An alternative to immediate operative intervention of patients with zone I and zone III injuries depends on the availability of interventional radiology. Angiography and embolization can be utilized in these patients. However, involvement of interventional radiologist should not delay definitive intervention.

Further reading

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2. Bagheri SC, Khan HA, Bell RB. Penetrating neck injuries. *Oral Maxillofac Surg Clin North Am* 2008;20(3):393–414.

CASE 2 | “I’ve Got Blood in my Eye”

Chris S. Bergstrom and Alexander B. Baer

Answer: E

Diagnosis: Traumatic hyphema

Discussion: A traumatic hyphema is defined as blood in the anterior chamber of the eye, usually the result of blunt globe trauma. The blood may be suspended in the aqueous humor (as pictured in the case), layered in the anterior chamber (Figure 2.1), or fill the entire anterior chamber. It is important to determine the mechanism of injury causing the hyphema. Complete ocular examination is important to rule out a ruptured globe. A dilated fundus examination or ultrasound should be performed to rule out posterior segment injury. A computed tomography (CT) scan of the brain and orbits should be considered when globe rupture or intraocular foreign body is suspected.

The intraocular pressure should be measured in all patients with a hyphema provided globe rupture has been ruled out. Intraocular pressure elevation greater than 25 mmHg occurs in 25% of patients with a hyphema. The pressure elevation is due to trabecular meshwork obstruction by red blood cells or damage to the normal aqueous outflow channels. Intraocular pressure can be easily measured in the emergency department using

various instruments, such as a Tono-Pen. Black and Mediterranean patients should be screened for sickle cell trait or disease.

Treatment for hyphemas is mainly supportive unless the intraocular pressure is uncontrolled. Patients should be confined to bed rest or limited activity. Elevate the head 30 degrees. A metal shield should be placed over the injured eye at all times. Atropine 1% ophthalmic drops should be instilled twice a day to relieve ciliary spasms and enhance patient comfort. Prednisolone acetate 1% ophthalmic suspension instilled four times a day will help suppress inflammation in the injured eye. Patients should avoid aspirin-containing products.

Patients with elevated intraocular pressure can usually be managed with topical antiglaucoma therapy. Treatment is aimed at reducing aqueous production. A topical beta-blocker (timolol or levobunolol 0.5%) twice a day may be combined with an alpha-agonist (brimonidine 0.2%) three times a day and a topical carbonic anhydrase inhibitor (dorzolamide 2%) three times a day. If unsuccessful, oral acetazolamide 500 mg twice a day may be added. However, carbonic anhydrase inhibitors should be avoided in patients with sickle cell disease or trait since these medications may reduce the anterior chamber pH and induce sickling. Despite medical therapy, approximately 5% of patients with a hyphema will require surgical intervention to control their intraocular pressure. Ophthalmology consultation should be obtained for all patients with hyphema since these patients will require long-term monitoring for the development of glaucoma.

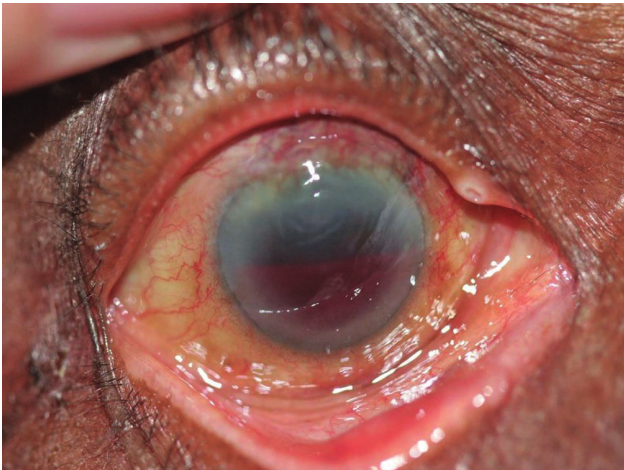


Figure 2.1 Layered hyphema in the anterior chamber.

Further reading

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2. Walton W, Von Hagen S, Grigorian R, Zarbin M. Management of traumatic hyphema. *Surv Ophthalmol* 2002;47(4):297–334.
3. Sankar PS, Chen TC, Grosskreutz CL, Pasquale LR. Traumatic hyphema. *Int Ophthalmol Clin* 2002;42(3):57–68.

CASE 3 | Forearm Fracture After Falling

Alexander B. Baer

Answer: E

Diagnosis: Monteggia fracture

Discussion: Monteggia fracture is an eponym for an ulnar fracture associated with a dislocation of the radial head. The dislocation of the radial head (note how the line along the axis of the radius does not intersect the capitulum in Figure 3.1) can be easily overlooked if the radiographs fail to include the elbow. If the radial head dislocation is missed, prolonged disarticulation and subsequent disability may occur. Monteggia fractures can result from falling on an outstretched hand with forced pronation. The energy exerted in fracturing the ulna travels along the interosseous membrane, pulling the radial head from the annular ligament.

Reduction of the radial head must be achieved expeditiously, followed by splinting of the forearm in a position of function with the wrist extended. Monteggia fractures are often managed with internal fixation because of the increased risk of nonunion.

Radial motor nerve injury can occur from stretching or compressing the nerve as it passes across the elbow. The

radial nerve becomes the posterior interosseous nerve, which supplies the extensor muscles of the wrist, fingers, and thumb. Motor neuropathies are usually treated with conservative management, with surgical exploration being reserved for those who do not regain function within 2–3 months.

Galeazzi fracture is an eponym for a radial fracture associated with the dislocation of the distal radioulnar joint. Galeazzi fractures are typically treated with open reduction and internal fixation.

Further reading

1. Wilkins KE. Changes in the management of Monteggia fractures. *J Pediatr Orthop* 2002;22(4):548–54.
2. Perron AD, Hersh RE, Brady WJ, Keats TE. Orthopedic pitfalls in the ED: Galeazzi and Monteggia fracture-dislocation. *Am J Emerg Med* 2001;19(3):225–8.



Figure 3.1 Monteggia fracture, with the long arrow pointing to a proximal ulnar fracture and the short arrow pointing to a radial head dislocation.

CASE 4 | A Neonate with Fever and Rash

Answer: A

Diagnosis: Neonatal herpes simplex virus infection

Discussion: Herpes simplex virus (HSV) infection is a potentially devastating disease in the neonatal period. It can result from exposure to either herpes simplex type 1 (HSV-1) or type 2 (HSV-2). Most neonatal exposures occur during birth (85%), although *in utero* (5%) and postnatal exposures (10%) are possible.

Newborns are at much greater risk of obtaining an HSV infection from a mother who is having her first, active episode of genital herpes near delivery than from a mother who is having a recurrent infection. Some mothers can have subclinical infections and have asymptomatic viral shedding that goes undetected. As the virus has a prolonged incubation time (5–21 days), a healthy-appearing neonate may be discharged from the nursery and subsequently become ill. Some other risks factors for transmission from mother to neonate include the following: prematurity, use of fetal scalp electrodes or other procedures that are traumatic to the baby's skin (e.g., forceps), rupture of membranes lasting longer than 4 hours, lack of maternal antibodies to HSV, and maternal age less than 21 years. Cesarean section reduces the transmission risk, particularly if rupture of membranes has not occurred.

Neonatal HSV infection is classified in one of three forms. The first of these is when the infection is localized to the skin (in the form of a characteristic vesicular rash), eyes, and mouth (SEM). The next is central nervous system (CNS) disease, which can involve multiple parts of the brain and lead to severe damage. Disseminated disease involves multiple organ systems (including the CNS, adrenal glands, skin, eyes, and mouth) but may show preference for the lungs and liver. Typically, SEM and disseminated disease presents earlier in life (10–12 days), while CNS disease presents later (16–19 days). *Skin lesions are not always present in disseminated and CNS disease.* More than 20% of infants with disseminated HSV infection will never display the characteristic vesicular

rash. Of those with CNS disease, only 60–70% of infants ever exhibit vesicles. HSV infection should be strongly considered in the differential diagnosis of any acutely ill neonate (although infection can occur at other ages) with any of the following: seizures, unexplained acute hepatitis, skin vesicles, septic presentation (especially with negative bacterial cultures), or the presence of HSV risk factors.

For diagnosis, viral culture remains the most definitive modality, with possible sites to culture including skin vesicles, oropharynx, conjunctivae, urine, blood, stool, and cerebrospinal fluid (CSF). Polymerase chain reaction of the CSF has gained widespread use to rapidly delineate involvement of the CNS due to its quick turnaround and high sensitivity and specificity. A chest radiograph and liver transaminase levels are also useful in suspected disseminated disease due to the affinity of HSV for the lungs and liver. Serologies in an infant are unlikely to change clinical management if HSV is suspected. If IgG is detected, it is impossible to determine whether it is native or transplacentally acquired from the mother.

High-dose intravenous acyclovir (60mg/kg per day divided every 8 hours) is the treatment of choice for neonatal HSV infection. Mortality from CNS and disseminated HSV infection can be high when untreated; therefore *acyclovir should be started immediately with any suspicion of neonatal HSV infection.*

Further reading

1. Colletti JE, Homme JL, Woodridge DP. Unsuspected neonatal killers in emergency medicine. *Emerg Med Clin North Am* 2004;22(4):929–60.
2. Kimberlin DW. Neonatal herpes simplex infection. *Clin Microbiol Rev* 2004;17(1):1–13.
3. Lewis P, Glaser CA. Encephalitis. *Pediatr Rev* 2005;26(10):353–63.

CASE 5 | A Missing Button Battery

Answer: E

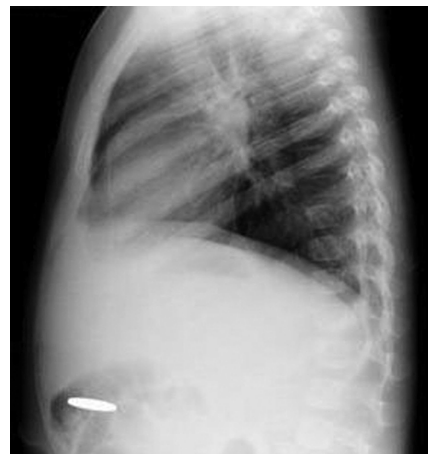
Diagnosis: Button battery ingestion with esophageal impaction

Discussion: Ingestions of foreign bodies by toddlers are a relatively common presenting complaint in pediatric

emergency departments. The majority of battery ingestions (68%) occur in children younger than 6 years, and an additional 20% occur in children aged 6–19 years. Most (about 90%) button battery ingestions are asymptomatic and are diagnosed based on parental history, but button



Figure 5.1 Radiographs of an ingested coin. Note both sides are uniformly the same size and the object is thin.



battery ingestions require prompt attention as they often must be managed differently from other ingestions (such as of coins). Button batteries can cause mucosal injury by leaking battery contents, through electrical discharge, and from pressure necrosis. Although clinically significant outcomes take place in only about 1% of ingestions, the incidence of serious complications has been increasing. This is thought to be due to an overall increase in household use of items containing button batteries and the increased use of new larger (20mm), higher voltage (3V) cells using lithium technology.

Symptoms are not a reliable predictor of the presence of a button battery retained in the gastrointestinal tract. Radiographic localization of the battery is an important first step in determining the management strategy, because batteries retained within the esophagus are managed differently from batteries found further along the gastrointestinal track. Anteroposterior and lateral films are required to evaluate for an esophageal battery.

Button batteries have an anode and a cathode. This often gives them the characteristic double-density shadow caused by the step-off between the anode and the cathode. This finding can help to differentiate the battery from an ingested coin (Figures 5.1 and 5.2).

Batteries retained within the esophagus are typically entrapped at one of three levels of anatomic narrowing: the level of the cricopharyngeus muscle, the level of the aortic arch, and the level of the lower esophageal sphincter. Mucosal damage may develop within 2–4 hours following ingestion with retention of a button battery within the esophagus. If a button battery remains retained in the esophagus, ulceration, perforation, tracheoesophageal fistula, and esophageal stricture may occur (see Figures 5.3–5.5). However, greater than 90% of all batteries ingested pass through the gastrointestinal tract without



Figure 5.2 Button batteries of similar diameter to a coin are thicker and have a step-off; the anode side has a smaller diameter than the cathode side.



Figure 5.3 Disc battery impaction site as seen through endoscopy.

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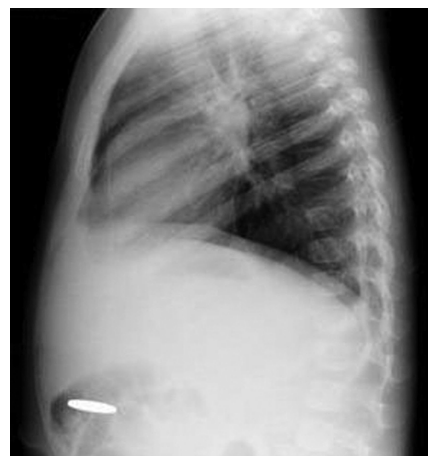
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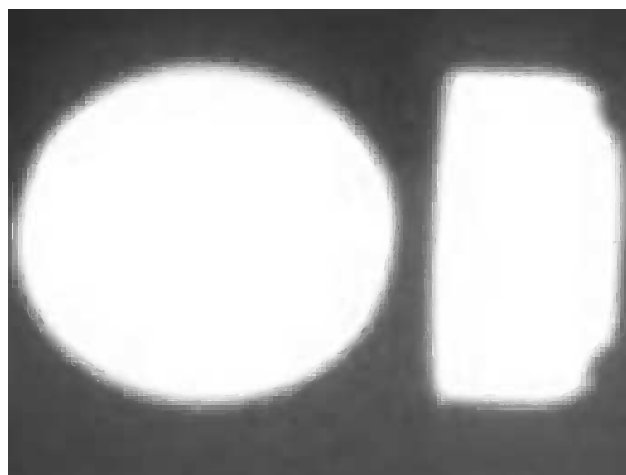


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Figure 5.3 Disc battery impaction site as seen through endoscopy.



Figure 5.4 The button battery removed.



Figure 5.5 Mucosal ulceration is clearly seen through endoscopy following disc battery removal.

development of complications. As a result of the typically benign course of battery ingestions, it is recommended that batteries distal to the esophagus be followed with outpatient serial abdominal X-rays and stool examination to prove passage. Batteries retained within the esophagus are more likely to have associated complications and should be removed emergently under direct visualization.

Further reading

1. Litovitz T, Whitaker N, Clark L, et al. Emerging battery-ingestion hazard: clinical implications. *Pediatrics* 2010;125:1168–77.
2. Samad L, Ali M, Ramzi H. Button battery ingestion: hazards of esophageal impaction. *J Pediatr Surg* 1999;34(10):1527–31.
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CASE 6 | Anorexia, Hair Loss, and Fingernail Bands

Answer: A

Diagnosis: Arsenic toxicity

Discussion: Numerous reports of acute intoxication following criminal poisoning have been published (in the case presented, the patient's wife was placing it into his food). Clinical effects may appear minutes, hours, or days after exposure depending on the dose and type of arsenic consumed. The earliest manifestations of acute poisoning are severe gastrointestinal symptoms of nausea, vomiting, abdominal pain, and diarrhea. The diarrhea may resemble that seen with cholera and can appear as "rice water." These symptoms occur within minutes to several hours after ingestion. The patient often complains of muscle cramps and thirst. Cardiovascular and respiratory symptoms include hypotension, shock, pulmonary edema, acute respiratory distress syndrome, and heart failure.

Prolonged or additional symptoms may occur for days to weeks after an acute exposure. Neurologic symptoms

such as headache, confusion, personality change, irritability, hallucinations, delirium, and seizures may develop or persist. Peripheral neuropathy commonly occurs 1–3 weeks after an acute poisoning. The peripheral neuropathy may last for years. Progressive neuropathy may be misdiagnosed as Guillain-Barré syndrome. Sensory symptoms may include numbness, tingling, lightheadedness, delirium, encephalopathy, muscle weakness, and severe pain following superficial touch of the limbs.

An accumulation of arsenic in the skin, hair, and nails causes clinical effects such as hyperpigmentation, keratoses of the palms and soles, melanosis, and hair loss. Mees' lines (Figure 6.1) may be seen and correspond with significant poisonings that have occurred previously. A metallic taste and garlic odor of the breath and sweat may be noted. Definitive diagnosis is made by an elevated urinary arsenic level.



Figure 5.4 The button battery removed.



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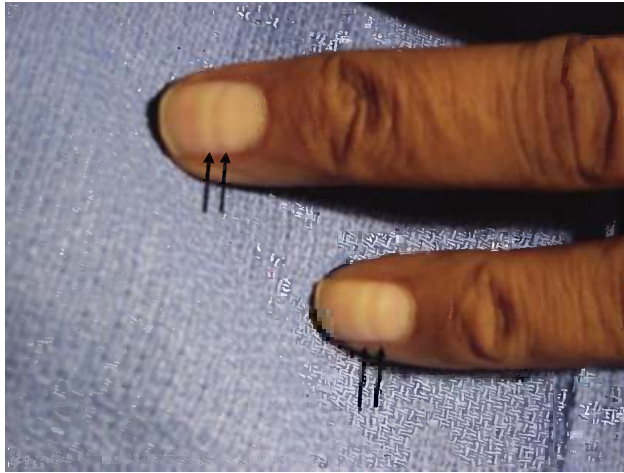


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Further reading

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CASE 7 | Wide Complex Tachycardia in a Young Adult

Answer: C

Diagnosis: Antidromic tachycardia in Wolff–Parkinson–White syndrome

Discussion: The case rhythm strip demonstrates a wide complex tachycardia (WCT). The electrocardiogram reveals the classic electrocardiographic triad of Wolff–Parkinson–White (WPW) syndrome, including a shortened PR interval, widened QRS complex, and delta wave.

WPW syndrome is a form of ventricular pre-excitation involving an accessory conduction pathway. This accessory conduction pathway bypasses the atrioventricular (AV) node, creating a direct electrical connection between the atria and ventricles – in essence, removing the protective, rate-limiting effect of the AV node and subjecting the ventricles to excessive rates when the patient experiences a dysrhythmia. The ventricles are “pre-excited” with atrial impulse conduction over the accessory pathway (AP), which arrives at the ventricular myocardium sooner than the same impulse conducted through the AV node.

The electrocardiographic definition of WPW (Figure 7.1) relies on the following electrocardiographic features: (1) a PR interval less than 0.12 seconds; (2) slurring of the initial segment of the QRS complex (delta wave); (3) a widened QRS complex; and (4) secondary repolarization changes reflected in ST segment and T wave changes. The PR interval is shortened because the impulse progressing down the AP is not subjected to the physiologic slowing that occurs in the AV node. Thus, the ventricular myocardium is activated by two separate pathways (the AP and the AV node), resulting in a fused – or widened – QRS complex. The initial part of the complex, the delta wave,

represents aberrant activation of the ventricular myocardium through the AP, while the terminal portion of the QRS represents normal activation through the His–Purkinje system from impulses that have traveled through both the AV node and the AP. This classic triad of electrocardiographic findings, when encountered in the setting of a symptomatic dysrhythmia, represents WPW syndrome. These dysrhythmias include paroxysmal supraventricular tachycardia (also known as atrioventricular reciprocating tachycardia [AVRT]), atrial fibrillation, and ventricular fibrillation (Figure 7.2).

The most frequently encountered rhythm disturbance is AVRT, with two subtypes described; these two subtypes are classified based upon the direction of conduction through the AP (antegrade versus retrograde) and the resultant QRS complex width. Activation of the ventricular myocardium and impulse propagation occurs through either the AV node or the AP. With antegrade conduction through the AV node with impulse return to the atria via the AP, the AVRT is referred to as orthodromic. Orthodromic AVRT, the most common form of AVRT, presents electrocardiographically with a narrow QRS complex – and is indistinguishable from typical AV nodal reciprocating tachycardia, i.e., persistent supraventricular tachycardia (PSVT).

The least common form of AVRT is antidromic tachycardia, which is seen in approximately 10% of WPW PSVT patients. In this rhythm presentation, the AP conducts the impulse from the atria to the ventricles in antegrade fashion. The impulse returns to the atria via the bundle branches, His–Purkinje fibers, and the AV node.

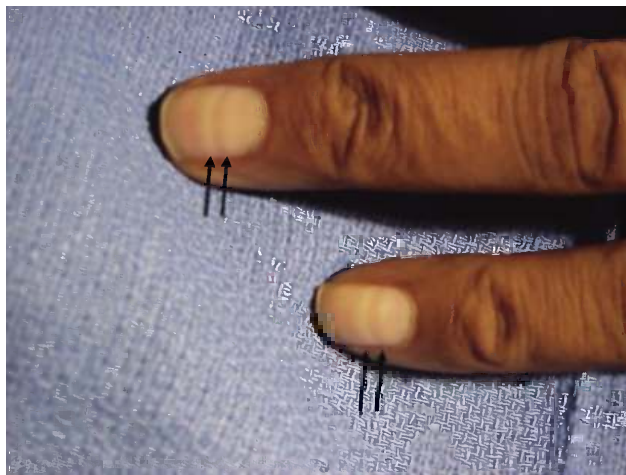


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represents aberrant activation of the ventricular myocardium through the AP, while the terminal portion of the QRS represents normal activation through the His–Purkinje system from impulses that have traveled through both the AV node and the AP. This classic triad of electrocardiographic findings, when encountered in the setting of a symptomatic dysrhythmia, represents WPW syndrome. These dysrhythmias include paroxysmal supraventricular tachycardia (also known as atrioventricular reciprocating tachycardia [AVRT]), atrial fibrillation, and ventricular fibrillation (Figure 7.2).

The most frequently encountered rhythm disturbance is AVRT, with two subtypes described; these two subtypes are classified based upon the direction of conduction through the AP (antegrade versus retrograde) and the resultant QRS complex width. Activation of the ventricular myocardium and impulse propagation occurs through either the AV node or the AP. With antegrade conduction through the AV node with impulse return to the atria via the AP, the AVRT is referred to as orthodromic. Orthodromic AVRT, the most common form of AVRT, presents electrocardiographically with a narrow QRS complex – and is indistinguishable from typical AV nodal reciprocating tachycardia, i.e., persistent supraventricular tachycardia (PSVT).

The least common form of AVRT is antidromic tachycardia, which is seen in approximately 10% of WPW PSVT patients. In this rhythm presentation, the AP conducts the impulse from the atria to the ventricles in antegrade fashion. The impulse returns to the atria via the bundle branches, His–Purkinje fibers, and the AV node.

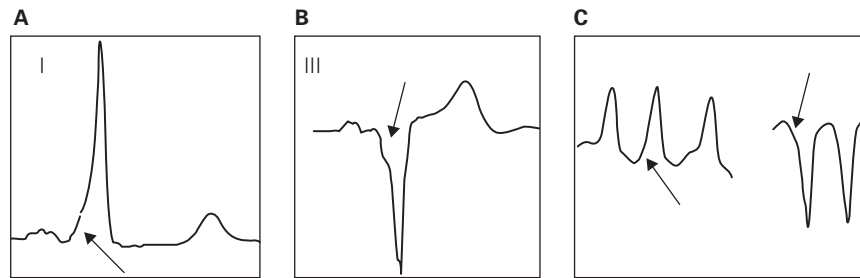


Figure 7.1 A. Normal sinus rhythm with PR interval shortening, a delta wave (arrow), and a widened QRS complex. B. Normal sinus rhythm with PR interval shortening, a delta wave (arrow), and a widened QRS complex. Note that the delta wave has a negative polarity. C. Antidromic tachycardia with wide QRS complexes. Note the initial slurring of the QRS complex, which is termed the delta wave (arrow).

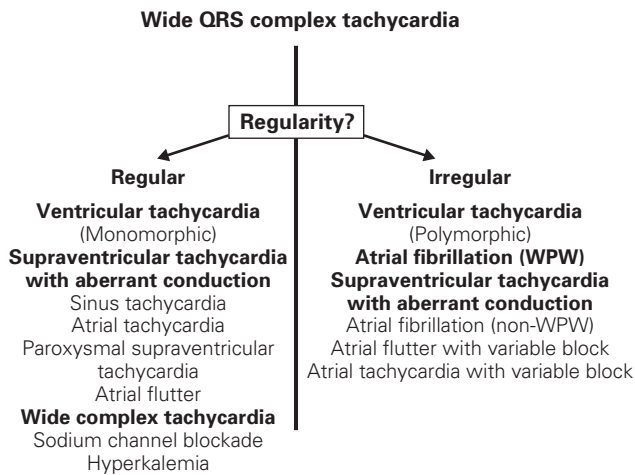


Figure 7.2 Differential diagnosis of wide complex tachycardia. Larger print size denotes the main categories, and smaller print the subcategories within these.

In this form of AVRT, the QRS complex is wide due to inefficient conduction of the impulse through the ventricular myocardium – i.e., the His–Purkinje system is not used. The QRS complexes appear wide (essentially, an exaggeration of the delta wave), and the ECG displays a very rapid, wide complex tachycardia that is indistinguishable from that of ventricular tachycardia. The ventricular rates are rapid, with a range of 180–240 beats per minute. This form of AVRT places the patient at risk for

arrhythmic decompensation due to the loss of AV node protection of the ventricle from rapid rates.

The initial treatment of the antidromic AVRT, i.e., the wide complex tachycardia, focuses on interrupting the re-entrant circuit. Electrical cardioversion should be applied to all patients with hemodynamic instability. Additionally, tachycardias with ventricular rates approaching 300 per minute are at an increased risk for ventricular fibrillation, resulting from myocardial ischemia due to reduced perfusion of the heart as well as subsequent depolarizations falling on the electrically vulnerable repolarization phase. In the hemodynamically stable patient, the agent of first choice would be either procainamide or amiodarone. Agents such as calcium channel antagonists, beta-adrenergic blocking agents, or digoxin, which act primarily on the AV node, are contraindicated since they will facilitate conduction down the AP and could potentially lead to an increased ventricular rate with ventricular fibrillation.

Further reading

1. Rosner M, Brady WJ, Kefer M, Martin ML. Electrocardiography in the patient with the Wolff-Parkinson-White syndrome: diagnostic and initial therapeutic issues. *Am J Emerg Med* 1999;17:705–14.
2. Wolff L, Parkinson J, White PD. Bundle-branch block with short PR interval in healthy young people prone to paroxysmal tachycardia. *Am Heart J* 1930;5:685–704.

CASE 8 | Wide Complex Tachycardia in an Older Male Patient

Answer: C

Diagnosis: Wide complex tachycardia – ventricular tachycardia

Discussion: The two electrocardiographic rhythm strips in this case (lead II and the V lead) demonstrate a wide QRS complex tachycardia. The QRS complex is markedly

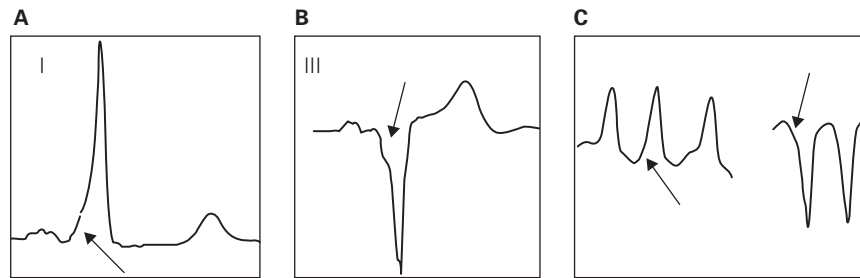


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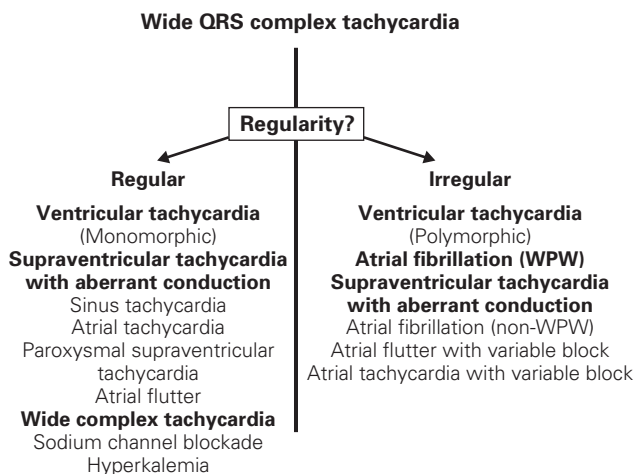


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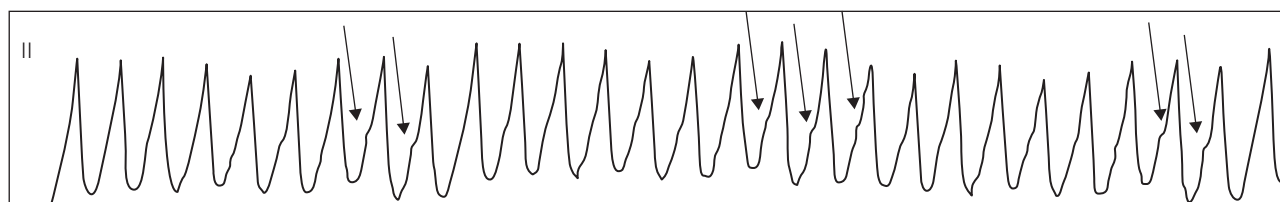


Figure 8.1 The presence of AV dissociation in lead II (arrows) is very strongly suggestive of ventricular tachycardia as the rhythm diagnosis.

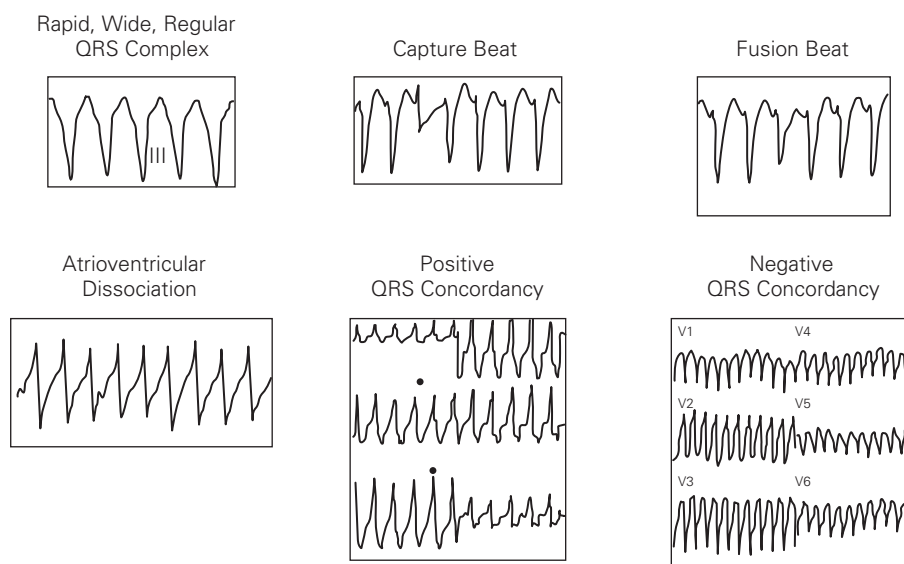


Figure 8.2 ECG features suggestive of VT.

wide with a very rapid, regular rhythm. There is also the presence of atrioventricular (AV) dissociation in lead II (Figure 8.1, arrows), which is very strongly suggestive of ventricular tachycardia (VT) as the rhythm diagnosis.

A wide QRS complex tachycardia (WCT) is defined electrocardiographically as a dysrhythmia with a QRS complex greater than 0.12 seconds in duration and a ventricular rate greater than 120 beats per minute. In patients presenting with a WCT, the differentiation of VT from supraventricular tachycardia (SVT) with aberrant ventricular conduction is difficult. Aberrant ventricular conduction may be due to a pre-existing bundle branch block, a functional (rate-related) bundle malfunction resulting in a widened QRS complex when the heart rate exceeds a characteristic maximum for that patient, or accessory AV conduction as encountered in pre-excitation syndromes (Wolff–Parkinson–White syndrome).

Certain clinical variables may support a diagnosis of VT in the WCT presentation. Patient age greater than 50 years suggests VT; younger age is associated with SVT yet in a less robust fashion. Consideration of the past medical history also is helpful; a history of angina, myocardial infarction, coronary artery bypass grafting, valvular heart disease, or congestive heart failure strongly suggests VT. It must be stressed that the presence or

absence of hemodynamic instability does not support either diagnosis – either dysrhythmia can present with instability or stability.

Electrocardiographic variables suggestive of VT (Figure 8.2) include a broad QRS complex, AV dissociation, fusion beats, capture beats, and QRS complex features. When noted, AV dissociation is diagnostic of VT; unfortunately, AV dissociation is uncommon and, if present, difficult to discern. The second useful feature in establishing a diagnosis of VT is the presence of fusion beats (a combination of a supraventricular impulse with a ventricular impulse, producing a QRS complex of different morphology) or capture beats (a supraventricular impulse passing through the AV node, causing an electrical depolarization of the ventricles). The finding of either a fusion or a capture beat confirms the diagnosis of VT, but again its utility is limited. Fusion and/or capture beats are observed in less than 10% of cases of VT. QRS complex concordance (precordial QRS complexes entirely positive or negative) favors VT.

The limited usefulness of these features has led to the construction of several stepwise approaches to the diagnosis of WCT. For example, the approach suggested by Brugada and Brugada involves a four-step algorithm. This tool as well as numerous similar proposals, however,

are somewhat cumbersome. Also, the majority of these protocols have a default diagnosis of SVT with aberration. Clearly, defaulting to a less severe diagnosis is problematic, fraught with error and danger for both patient and clinician. Certainly, the clinician is required to treat the patient – not the ECG. In other words, with the idea that the specific rhythm diagnosis may not be possible, the clinician should focus on the patient and his or her hemodynamic status, and base initial therapy on the entire clinical picture. Furthermore, the clinician should not default to a less severe illness – SVT with aberration. If in

doubt, manage the patient as if VT is the rhythm diagnosis.

Further reading

1. Hudson KB, Brady WJ, Chan TC, et al. Electrocardiographic features of ventricular tachycardia. *J Emerg Med* 2003;25: 303–14.
2. Brugada P, Brugada J, Mont L, et al. A new approach to the differential diagnosis of a regular tachycardia with a wide QRS complex. *Circulation* 1991;83:1649–59.

CASE 9 | Muscle Spasms Following a Spider Bite

Answer: E

Diagnosis: Black widow envenomation

Discussion: Black widow spiders (*Latrodectus* species) are found over a wide geographic range on every continent but Antarctica. The female spider is substantially larger than the male, has fangs large enough to penetrate human skin, and is therefore responsible for producing the characteristic symptoms related to toxicity. The female is shiny black in color with a variable red pattern consisting of dorsal stripes or dots. The design may also demonstrate the traditional hourglass of varying size on its ventral abdomen. The spider's web has a disheveled appearance and is often found in dark, dry locations near human habitation. Bites more commonly occur in warmer seasons.

The venom of the black widow contains alpha-latrotoxin. This toxin binds to multiple receptors, resulting in the unregulated opening of cation channels and the subsequent influx of calcium at presynaptic neurons. Elevated cytosolic calcium causes a substantial release of neurotransmitters including acetylcholine, norepinephrine (noradrenaline), and dopamine from presynaptic neurons. The toxin also prevents the reuptake of neurotransmitters. The increased amount of neurotransmitters results in activation of both the sympathetic and cholinergic systems and in stimulation of the neuromuscular junction.

Initially, a pinprick sensation may be felt at the bite site. However, the initial pain may go unnoticed. A small erythematous lesion or local induration may be seen at the site of injection. Systemic signs and symptoms may develop and subsequently progress over 60–120 minutes, and can last for days. Muscle cramping is a characteristic finding associated with black widow envenomation, typically beginning at the bite site and progressing proximally. The cramps may be mild and remain localized at

the site or spread proximally from the bite and involve any muscle group, becoming severe and diffuse. Severe cases may develop opisthotonus posturing, demonstrated by extreme extension of the torso, or abdominal rigidity mimicking a surgical abdomen. Most clinical symptoms such as nausea, vomiting, headache, palpitations, tachycardia, diaphoresis, facial edema, and priapism are not life-threatening. In some cases, the bite can result in considerable morbidity, especially at the extremes of age or in pregnancy, resulting in miscarriage, seizures, hypertensive crisis, and cardiovascular collapse. The diagnosis of black widow envenomation is made solely on the clinical presentation; there are no clinical laboratory tests available to confirm the diagnosis. Presentation may simulate other acute conditions such as appendicitis. A serum creatine phosphokinase level may be helpful to evaluate for the presence of concurrent rhabdomyolysis.

Wounds should be thoroughly irrigated and tetanus prophylaxis administered if appropriate. Patients should be monitored for at least 6 hours. Hospitalization is recommended for pregnant women, elderly individuals with cardiovascular risks, and symptomatic children. In patients who manifest severe pain, oral or parenteral opioid analgesics should be administered. If patients demonstrate progressive muscle spasms, antispasmodics, such as diazepam, may provide additional relief. Methocarbamol and dantrolene have been suggested but have been unsuccessful in routine treatment. Intravenous calcium is no longer recommended as it has not been shown to offer any significant benefit. Tourniquets have no role in the first aid management of black widow envenomations.

Latrodectus mactans antivenin (equine-derived) is effective at improving severe clinical effects associated with toxicity. The antivenin has been shown to be of some

are somewhat cumbersome. Also, the majority of these protocols have a default diagnosis of SVT with aberration. Clearly, defaulting to a less severe diagnosis is problematic, fraught with error and danger for both patient and clinician. Certainly, the clinician is required to treat the patient – not the ECG. In other words, with the idea that the specific rhythm diagnosis may not be possible, the clinician should focus on the patient and his or her hemodynamic status, and base initial therapy on the entire clinical picture. Furthermore, the clinician should not default to a less severe illness – SVT with aberration. If in

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Latrodectus mactans antivenin (equine-derived) is effective at improving severe clinical effects associated with toxicity. The antivenin has been shown to be of some

benefit up to 90 hours after exposure. However, its use is limited to those patients manifesting significant toxicity not relieved by conventional therapy, or those with health problems that place them at increased risk for complications (such as uterine contractions in a pregnant female). The antivenin carries a risk of anaphylaxis; therefore, administration should be done in a hospital setting with full resuscitation capabilities.

Further reading

1. Vetter RS, Isbister GK. Medical aspects of spider bites. *Annu Rev Entomol* 2008;53:409–29.
2. Diaz DH, Leblanc KE. Common spider bites. *Am Fam Physician* 2007;75:869–73.
3. Singletary EM, Rochman AS, Bodmer JC, Holstege CP. Envenomations. *Med Clin North Am* 2005;89(6):1195–224.

CASE 10 | Necrotic Skin Lesion

Answer: C

Diagnosis: Pyoderma gangrenosum

Discussion: Pyoderma gangrenosum (PG) is an uncommon inflammatory, painful, ulcerating skin disease of unknown etiology with three clinically distinct variants. These variations are: classic PG, characterized by ulcers on the lower legs; atypical PG, characterized by superficial ulcerations with a bluish-gray border located typically on the upper extremities and face; and peristomal PG, characterized by ulcers occurring around stomas in patients with inflammatory bowel disease (IBD). PG typically affects adults 20–60 years old, with women being affected slightly more frequently than men. PG may have an acute, relapsing, or chronic course, with relapsing or chronic courses associated with underlying disease. Approximately 50% of cases are associated with one of the following four main categories of systemic disease:

1. IBD, the most common cause (e.g., Crohn's disease or ulcerative colitis; 20–30% of cases)
2. Hematologic diseases (e.g., acute lymphoid and myeloid leukemias, myeloma, or monoclonal gammopathy; 15–25% of cases)
3. Rheumatologic diseases (e.g., rheumatoid arthritis or lupus erythematosus; 20% of cases)
4. Hepatic diseases (e.g., chronic active hepatitis or primary biliary cirrhosis)

The remainder of PG cases are idiopathic.

PG usually presents initially as a small pustule or nodule that some patients attribute to a spider bite. The lesion typically enlarges and ulcerates. The resulting ulcer may be covered with necrotic debris, an eschar, or small abscesses, and may have an associated mucopurulent and hemorrhagic exudate. Classically, the ulcer has a distinct violaceous rolled-up margin that is elevated, undermined, and painful. PG lesions can be a few centimeters wide or span the length of an entire limb. The lesions typically heal with a characteristic slightly depressed, punched-out scar.

Patients with PG may also complain of fever, malaise, gastrointestinal symptoms, and arthralgias. The evaluation of a patient with an ulcer should be guided by a

careful evaluation of the patient's current and past medical history and physical findings. PG can be diagnosed only after other causes of ulcers have been excluded. Other etiologies of ulcers include vascular, traumatic, infectious (e.g., bacterial, fungal, atypical mycobacterial, or viral), inflammatory (e.g., vasculitic), neoplastic (e.g., basal cell carcinoma or squamous cell carcinoma), and factitial. Dermatologic consultation is highly recommended to identify the cause of the ulcer. Histopathologic examination and culture of tissue, rather than a superficial culture of the ulcer base, are the most definitive ways to exclude other causes of ulcers. Performing a wedge-shaped incisional biopsy from perilesional skin toward the center of the ulcer, traversing the ulcer edge, is recommended as a way to obtain sufficient tissue to establish a diagnosis; if that is not possible, several punch biopsies of various areas of the ulcers can be performed.

Currently, there is no gold standard treatment for PG. It can be treated locally and systemically with immunosuppressive therapies. These therapies will depend on the patient's overall medical condition, the associated underlying disorder, the toxicity of the therapies, the size and depth of the lesion, the patient's immune status, and the response to the current therapy. The most commonly used immunosuppressive agents used to treat PG are intralesional or oral glucocorticoids. However, in cases in which glucocorticoids are ineffective or cannot be tolerated, alternative treatments include cyclosporine, dapsone, tumor necrosis factor alpha inhibitors, azathioprine, intravenous immunoglobulin, dapsone, thalidomide, methotrexate, cyclophosphamide, azathioprine, chlorambucil, and tacrolimus. Debridement is contraindicated, as lesions typically worsen following trauma in a phenomenon known as pathergy. Meticulous wound care is important to prevent pathergy and infection. Wound care treatments can include silver-impregnated, alginate, and hydrocolloidal dressings, topical antibiotics, sterile saline washes, and barrier creams (e.g., zinc oxide paste). Hyperbaric oxygen treatment is also sometimes used. The prognosis for patients with PG is generally favorable if an

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Further reading

1. Halac U, Dhaybi RA, Powell J, et al. Unusual association between autoimmune hepatitis and severe pyoderma gangrenosum. *J Pediatr Gastroenterol Nutr* 2010;50:219–21.
2. Miller J, Yentzer BA, Clark A, et al. Pyoderma gangrenosum: a review and update on new therapies. *J Am Acad Dermatol* 2010;62:646–54.
3. Ruocco E, Sangiuliano S, Gravina AG, et al. Pyoderma gangrenosum: an updated review. *J Eur Acad Dermatol Venereol* 2009;23:1008–17.

CASE 11 | Intense Pain Following High-pressure Injection Injury

Answer: D

Diagnosis: High-pressure injection injury

Discussion: Injection injuries that involve the hand or upper extremity are uncommon but are very high-risk. Most are job-related. The usual mechanism is the injection of fuel oil, grease, cement, paints, or solvents into the body through high-pressure industrial equipment. The lower the viscosity of the injected substance, the higher the potential for spread through soft tissue. A pressure of 100 pounds per square inch (psi) can break the skin. It is not uncommon for airless spray-guns or fuel injectors to generate up to 3,000–5,000 psi.

The patient who presents with this type of injury is typically a young male with an injury to the nondominant hand. The injured site commonly appears as a small

puncture with some surrounding soft tissue swelling. Clinicians can sometimes be misled by this benign presentation, which can delay definitive care. Care delays can increase the chance of significant functional morbidity and/or loss of limb.

Emergent management should include tetanus prophylaxis, analgesia, and broad-spectrum antibiotics. A digital block should not be utilized as this may worsen vascular compromise. Radiographs of the involved areas can help determine the extent of the soft tissue spread of the injected material. Some, but not all, of the injectable materials are radio-opaque. Also, subcutaneous emphysema caused by the high-pressure injection may be appreciated on X-ray. Immediate consultation for surgical decompression (Figure 11.1), exploration, and debridement is required to maximize recovery and functional outcome.



Figure 11.1 Surgical exploration of the case described in the text. Note the marked tissue edema and damage induced.

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1. Verhoeven N, Hierner R. High-pressure injection injury of the hand; an often underestimated trauma: case report with study of the literature. *Strategies Trauma Limb Reconstr* 2008;3(1): 27–33.
2. Hogan CJ, Ruland RT. High-pressure injection injuries to the upper extremity: a review of the literature. *J Orthop Trauma* 2006;20(7):503–11.
3. Gutowski KA, Chu J, Choi M, Friedman DW. High-pressure hand injection injuries caused by dry cleaning solvents: case reports, review of the literature, and treatment guidelines. *Plast Reconstr Surg* 2003;111(1):174–7.

Acknowledgement: We thank Tracy Reilly, MD for her contribution to this case in the previous edition.

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The patient who presents with this type of injury is typically a young male with an injury to the nondominant hand. The injured site commonly appears as a small

puncture with some surrounding soft tissue swelling. Clinicians can sometimes be misled by this benign presentation, which can delay definitive care. Care delays can increase the chance of significant functional morbidity and/or loss of limb.

Emergent management should include tetanus prophylaxis, analgesia, and broad-spectrum antibiotics. A digital block should not be utilized as this may worsen vascular compromise. Radiographs of the involved areas can help determine the extent of the soft tissue spread of the injected material. Some, but not all, of the injectable materials are radio-opaque. Also, subcutaneous emphysema caused by the high-pressure injection may be appreciated on X-ray. Immediate consultation for surgical decompression (Figure 11.1), exploration, and debridement is required to maximize recovery and functional outcome.



Figure 11.1 Surgical exploration of the case described in the text. Note the marked tissue edema and damage induced.

Further reading

1. Verhoeven N, Hierner R. High-pressure injection injury of the hand; an often underestimated trauma: case report with study of the literature. *Strategies Trauma Limb Reconstr* 2008;3(1): 27–33.
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Acknowledgement: We thank Tracy Reilly, MD for her contribution to this case in the previous edition.

CASE 12 | Prenatal Vitamin Overdose

Answer: A

Diagnosis: Iron toxicity

Discussion: Acute iron toxicity occurs from the ingestion of iron supplements. The total elemental iron ingested is dependent upon the type of preparation. Common formulations include ferrous gluconate (containing 12% of elemental iron), ferrous sulfate (20%), and ferrous fumarate (33%). Studies have shown that most iron poisonings are unintentional due to accidental ingestion of prenatal vitamins, which have a high content of iron about 60–65 mg elemental iron (multivitamins usually containing about 15–18 mg). Intentional ingestions are most commonly seen in females in their teens and twenties. Mortality from intentional ingestions has been reported to be as high as 10%.

Iron toxicity is dose-dependent. Toxic effects (gastrointestinal symptoms) generally occur at greater than 20 mg/kg elemental iron. Severe toxicity (shock) generally occurs at doses higher than 60 mg/kg. The primary mechanism of injury is free radical production and lipid peroxidation.

Five classic clinical phases have been described:

- **Phase 1** (30 minutes – 6 hours): Gastrointestinal distress predominates initially due to the direct corrosive effects of the iron. Symptoms include abdominal pain, diarrhea, and emesis. In severe cases, hypovolemic shock may occur, resulting in death. In most individuals with mild-to-moderate toxicity, gastrointestinal symptoms will resolve within a few hours and will not progress from this phase.
- **Phase 2** (6–24 hours): A “latent” phase may be seen, where gastrointestinal symptoms subside but end-organ toxicity continues. This phase might be absent in patients with severe toxicity. Care should be taken to continuously re-evaluate the patient to determine whether he or she is progressing to the next phase or whether the toxicity has truly resolved.
- **Phase 3** (6–72 hours): Multisystem organ failure ensues. Symptoms include hypotension, cardiotoxicity, oliguria, anuria, coagulopathy, lethargy, seizures, shock, coma, and possibly death.
- **Phase 4** (1–4 days): Fulminant liver failure may develop. Liver failure is the second most common cause of death.
- **Phase 5** (2–8 weeks): Initial gastrointestinal corrosive injury obstruction occurs at different levels from luminal scarring.

Evaluation includes a thorough history and physical examination. An iron level should be obtained and a repeat level drawn to assure that iron levels are not increasing. Peak iron concentrations usually occurs 4–6 hours after overdose. Serum iron levels over 500 µg/dL



Figure 12.1 The radiograph of the chapter case with arrows delineating the radio-opacity of the dissolved iron tablets in the stomach.

are commonly associated with systemic toxicity. Total iron-binding capacity is unreliable and should not be used to estimate free iron levels. Patient can have an anion gap metabolic acidosis. The iron tablets may be seen on abdominal X-rays (Figure 12.1). A negative X-ray does not rule out iron ingestion (children’s chewable multivitamin products are not radio-opaque).

There is limited utility of gastrointestinal decontamination following iron overdose. Ipecac and gastric lavage are generally not recommended. Activated charcoal does not adsorb iron and should not be administered. Whole-bowel irrigation may be useful, especially if tablets are visible on X-ray or levels are rising. Adequate fluid resuscitation and supportive care are the primary initial interventions. Deferoxamine is the antidote of choice as it chelates free iron and increases its excretion. Indications include significant clinical signs of toxicity (e.g., protracted vomiting or diarrhea), metabolic acidosis, shock, serum iron levels greater than 500 µg/dL and/or an X-ray positive for multiple pills. Deferoxamine infusions are given intravenously at a starting rate of 15 mg/kg per hour and continued for 6 hours. The patient should then be re-evaluated. Deferoxamine-induced hypotension may occur at fast rates due to histamine release, and adequate hydration should be assured before initiation of the infusion. As iron is chelated and excreted, the urine will develop a characteristic rusty-red (“vin rose”) appearance (Figure 12.2).



Figure 12.2 The “vin rose” urine of a patient who has iron toxicity and has been chelated with deferoxamine.

Further reading

1. Eldridge DL, Dobson T, Brady W, Holstege CP. Utilizing diagnostic investigations in the poisoned patient. *Med Clin North Am* 2005;89(6):1079–106.
2. Siff JE, Meldon SW, Tomassoni AJ. Usefulness of the total iron binding capacity in the evaluation and treatment of acute iron overdose. *Ann Emerg Med* 1999;33(1):73–6.
3. Mills KC, Curry SC. Acute iron poisoning. *Emerg Med Clin North Am* 1994;12(2):397–413.

CASE 13 | Blurred Vision Following Yard Work

Answer: E

Diagnosis: Jimson weed exposure

Discussion: Found throughout North America, Jimson weed (*Datura stramonium*) is a tall plant with trumpet-shaped white or violet flowers that bears a seed-containing fruit (Figure 13.1). Up to 50–100 seeds may be contained in each fruit. All parts of the plant contain parasympatholytic alkaloids including atropine, hyoscyamine, and scopolamine, with the highest concentration present in the seeds. One hundred seeds contain the equivalent amount of 6 mg atropine. Purposeful ingestion of Jimson weed is usually for its hallucinogenic effect. The means of ingestion usually involves eating the leaves, pods or seeds, or smoking the leaves and stems. Health hazards



Figure 13.1 *Datura stramonium* plant with seed pod.

arise from behavioral difficulties secondary to the central anticholinergic effects.

Parasympatholytic alkaloids, like those contained in Jimson weed, may also cause mydriasis through direct body contact. Unilateral mydriasis is a pharmacologic effect that can occur from direct instillation into the eye or from hand–eye transmission after handling the agent. Unilateral mydriasis can also occur following ocular exposure to other anticholinergic plants, scopolamine patches, and nebulized anticholinergic solution used for respiratory distress.

The emergency physician must consider a broad differential diagnosis for the nontraumatic fixed and dilated pupil, including physiologic anisocoria, third cranial nerve palsy, pharmacologic blockade, and a tonic (Adie) pupil. To differentiate between pharmacologic mydriasis and a third nerve palsy, 1% pilocarpine can be instilled into the mydriatic pupil. A dilated pupil secondary to third cranial nerve injury will respond to pilocarpine by constricting. In the presence of parasympatholytic alkaloids, competitive antagonism of pilocarpine occurs and the pupil will not constrict (exceptions may occur with ocular trauma or increased intraocular pressure). Additional evaluation of presenting anisocoria should be mandated by the clinical context of the physical findings.

Further reading

1. Andreola B, Piovan A, Dalt LD, et al. Unilateral mydriasis due to angel's trumpet. *Clin Toxicol* 2008;46:329–31.
2. Forrester MB. Jimsonweed (*Datura Stramonium*) exposures in Texas, 1998–2004. *J Toxicol Environ Health A* 2006;69:1757–62.



Figure 12.2 The “vin rose” urine of a patient who has iron toxicity and has been chelated with deferoxamine.

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CASE 14 | Foot Pain in a Gymnast

Answer: C

Diagnosis: Dancer's fracture (fracture of the distal shaft of the fifth metatarsal)

Discussion: A fracture of the distal shaft of the fifth metatarsal is commonly referred to as a "dancer's fracture" because of its association with ballet dancers (Figure 14.1). Dancer's fracture is characterized by a spiral-oblique fracture in the mid-shaft or neck of the fifth metatarsal. In one specific ballet technique (demi-pointe maneuver), a high twisting force is applied in the forefoot and can stress the fifth metatarsal enough to cause a frac-



Figure 14.1 Dancer's fracture (the arrow points to a fracture of the fifth metatarsal).

ture. This fracture can also result from direct trauma to the lateral foot. The classic patient presents with a painful limp but can bear weight on the affected foot. The most common physical examination finding is tenderness over the fifth metatarsal and swelling over the lateral aspect of the foot. Another common fracture that must be excluded is a Jones fracture (transverse fracture of the proximal diaphysis of the fifth metatarsal). Jones fractures have a significant risk of malunion or nonunion.

Radiographs of the sagittal, mediolateral, and anteroposterior planes of the affected foot must be obtained to assess for angulation and displacement of the distal fragment. Conservative treatment with a short-leg cast or stiff shoe for 2–6 weeks is recommended for most cases. Prolonged nonweight-bearing is associated with an increased risk for reflex sympathetic dystrophy. Closed reduction in the emergency department is required for fractures where there is an angulation of greater than 10 degrees or a displacement of greater than 3 mm. Due to the conservative management of this injury, special attention must be given to the sagittal plane radiograph to assess for angulation. A healed angulated fifth metatarsal shaft may be complicated by plantar keratosis in the future. Indications for open reduction include compartment syndrome, unstable or open fractures, or a failed closed reduction. Orthopedic consultation in the emergency department is recommended for multiple or displaced fractures.

Further reading

1. Goulart M, O'Malley MJ, Hodgkins CW, Charlton TP. Foot and ankle fractures in dancers. *Clin Sports Med* 2008;27(2): 295–304.
2. Fetzner GB, Wright RW. Metatarsal shaft fractures and fractures of the proximal fifth metatarsal. *Clin Sports Med* 2006;25(1): 139–50.
3. O'Malley MJ, Hamilton WG, Munyak J. Fractures of the distal shaft of the fifth metatarsal. "Dancer's fracture." *Am J Sports Med* 1996;24(2):240–3.

CASE 15 | A Child with Bruises of Different Ages

Answer: B

Diagnosis: Child abuse

Discussion: Much effort has been directed toward collecting and interpreting information about patterns of bruising in children in order to allay or corroborate the

suspicion of child abuse, and this remains an area of active research. Any concern based on bruising alone should always be interpreted in the context of the developmental status of the child, the clinical scenario, and the explanation given by caregivers (as well as the

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consistency of that explanation). While each child should be evaluated in such context, a review of the recent medical literature does support the finding that some patterns of bruising are more suggestive of abuse and should therefore alert the physician to consider that possibility.

Some patterns of bruising are found more often with accidental mechanisms and may be more reassuring. For example, bruising of the shins and knees in a child old enough to ambulate independently can be expected as developmentally appropriate. Bruises over bony prominences (e.g., the forehead) may also be less suspicious in appropriately mobile children.

In contrast, bruising in a child or infant that is not independently mobile is worthy of some suspicion, especially if the proposed mechanism is not plausible. Bruising in infants less than 6 months of age has been found to be extremely uncommon. Even as a child reaches 9 months, bruises remain relatively scarce. There are certain areas of the body where the discovery of bruises should be considered suspicious for abuse. These include areas away from bony prominences, and parts of the body that are heavily padded with underlying fat. Some of the concerning areas include the following: the buttocks, face (especially the philtrum and upper lip), neck, trunk, arms, and hands. Multiple bruising in clusters or with pathognomonic patterns also should be investigated. Examples of the latter might include bruises in a pediatric patient with distinctive imprints (such as from implements like an electrical cord or leather belt) or uniformity of size and shape.

When suspicious bruising is present, most experts agree that laboratory evaluation should be done to check for evidence of a bleeding disorder. Most experts recommend at least a platelet count and basic coagulation

studies such as a prothrombin time and activated partial thromboplastin time. Some argue for a more extensive evaluation, and this may be especially relevant if indicated by elements of a patient's personal clinical and family history.

Further evaluation is needed when suspicion of abuse exists. Most experts recommend a skeletal survey when this concern exists, especially in children under 2 years old, or if fractures suggestive of abuse (e.g., posterior rib fractures) are discovered. Computed tomography (CT) of the head is also recommended – keeping in mind that traumatic brain injury may still exist in infants with a normal-appearing physical examination. Altered mental status (as in this case) is even more suggestive of central nervous system involvement. If brain injury is identified, a formal retinal examination by an ophthalmologist is needed. The discovery of retinal hemorrhages is also a strong indicator of abusive head injury. Evaluation of possible abdominal trauma should be considered. Some experts advocate laboratory screening testing such as liver function tests and serum amylase levels to search for signs of abdominal injury. If such screening is positive, bruising of the trunk or abdomen is found, or bilious emesis is present, one should consider an abdominal CT.

Further reading

1. Feldman KW. The bruised premobile infant: should you evaluate further? *Pediatr Emerg Care* 2009;25(1):37–9.
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3. Horner G. Physical abuse: recognition and reporting. *J Pediatr Health Care* 2005;19(1):4–11.

CASE 16 | Sudden Shortness of Breath after Removal of a Central Line

Answer: C

Diagnosis: Air emboli

Discussion: The computed tomography (CT) scans from this patient, shown in Figures 16.1 and 16.2, demonstrate the presence of free air in the right ventricle and the right pulmonary artery (with filling defect), respectively. Emergent hyperbaric oxygen (HBO) therapy was performed. After HBO, the patient was asymptomatic. A repeat CT scan revealed complete resolution of the air emboli.

Air emboli can occur following central line insertion, manipulation, or removal. A spontaneously breathing patient generates negative intrathoracic pressure during

inspiration. If the catheter is open, this negative pressure can draw air into the vasculature and result in air emboli. The initial treatment of suspected air embolism is placement of the patient in the Trendelenburg position with a left lateral decubitus tilt to prevent movement of air into the right ventricular outflow tract. Oxygen 100% should be administered to aid resorption of the air. The definitive treatment for air emboli is HBO, which has been shown to reduce bubble absorption time by greater than 90%. The shorter the time interval from air embolism to hyperbaric treatment, the better the outcome.

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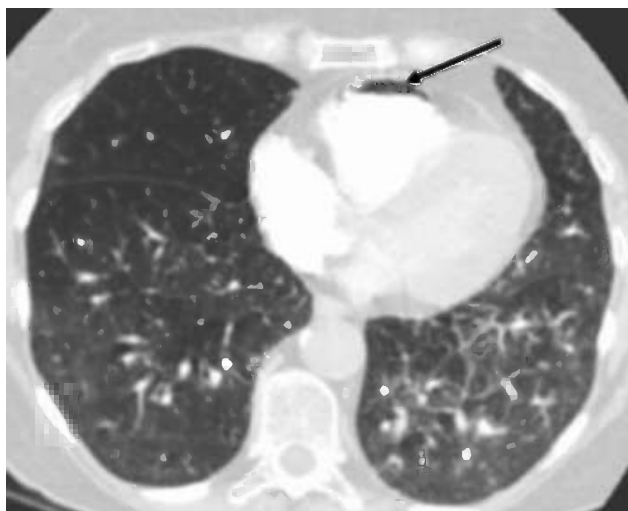


Figure 16.1 Arrow points to free air in the right ventricle.

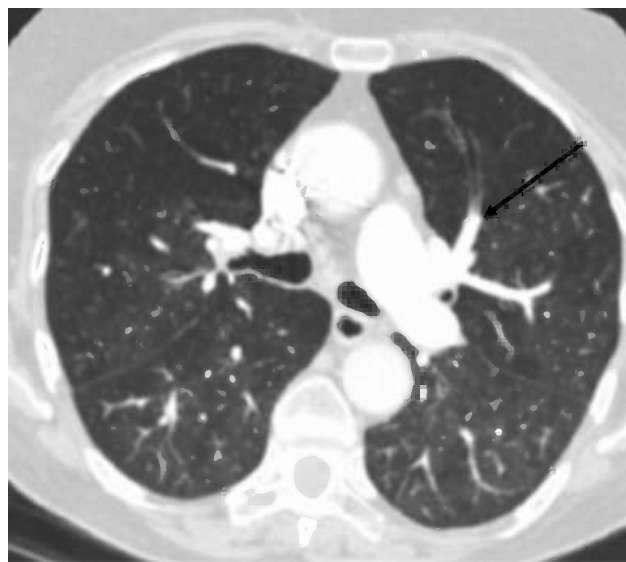


Figure 16.2 Arrow points to free air in the right pulmonary artery, with filling defect.

Further reading

1. McGee DC, Gould MK. Preventing complications of central venous catheterization. *N Engl J Med* 2003;348:1123–33.
2. Blanc P, Boussuges A, Henriette K, et al. Iatrogenic cerebral air embolism: importance of an early hyperbaric oxygenation. *Intensive Care Med* 2002;28:559–63.
3. Branger AB, Lambertsen CJ, Eckmann DM. Cerebral gas embolism absorption during hyperbaric therapy: theory. *J Appl Physiol* 2001;90:593–600.

CASE 17 | “My Eyes Are Yellow!”

Answer: B

Diagnosis: Jaundice secondary to hyperbilirubinemia

Discussion: Jaundice is the yellowish discoloration of the skin, mucous membranes, and sclerae caused by hyperbilirubinemia. Jaundice is not usually clinically apparent unless the serum bilirubin is above 3 mg/dL. It can be sign of many medical conditions ranging from the benign to the potentially fatal.

Jaundice results from a dysfunction in bilirubin metabolism at either the prehepatic, intrahepatic, or posthepatic phase. Bilirubin itself is produced from the metabolism of heme, which largely comes from breakdown of red blood cells.

The first step in the diagnosis of jaundice is determining the type of hyperbilirubinemia. Blood should be analyzed for levels of conjugated and unconjugated bilirubin. If the hyperbilirubinemia is primarily unconjugated, a disorder of bilirubin metabolism should be suspected. Increased bilirubin production that occurs from hemoly-

sis, ineffective erythropoiesis, massive transfusion, or the resorption of a large hematoma can exceed the liver’s conjugation process. Decreased hepatocellular uptake can be caused by drugs such as rifampin. Decreased conjugation is responsible for Gilbert’s or Crigler–Najjar syndrome and is the cause of physiologic jaundice of the newborn.

If the hyperbilirubinemia is predominantly conjugated, the etiology is likely to be secondary to liver disease, cholestasis, extrinsic bile duct compression, Dubin–Johnson or Rotor’s syndrome. Alanine aminotransferase and aspartate aminotransferase elevation suggests intrinsic liver disease or a cholestatic process. Normal to mildly elevated transaminases with an elevated alkaline phosphatase and gamma-glutamyltransferase suggests extrinsic bile duct compression. Etiologies of intrinsic liver disease include hepatitis, cirrhosis, hepatotoxins, metabolic disorders of the liver such as Wilson’s disease, HELLP syndrome, and infiltrative diseases such

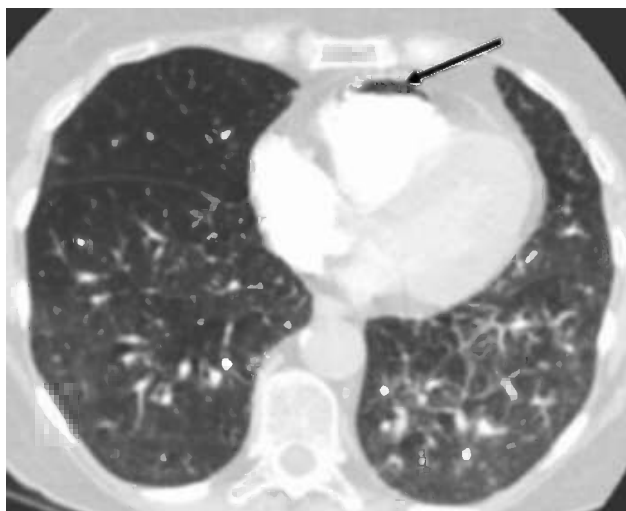


Figure 16.1 Arrow points to free air in the right ventricle.

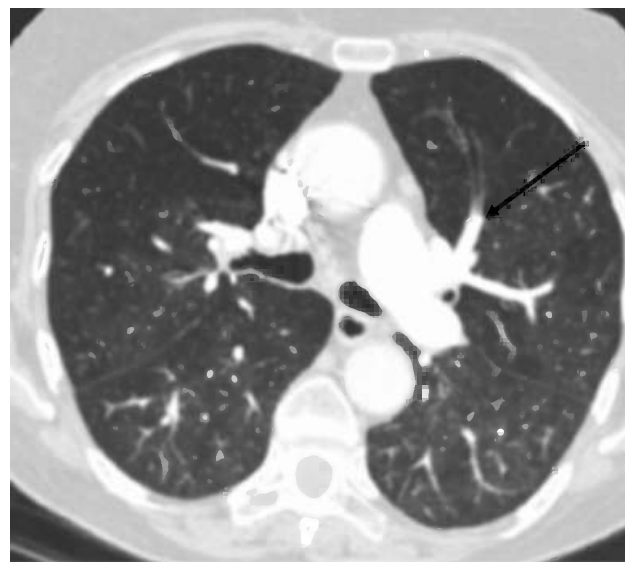


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as amyloidosis and metastatic carcinoma. Cholestatic diseases include graft-versus-host disease, primary biliary cirrhosis, and drugs such as erythromycin and chlorpromazine.

Extrinsic obstruction of the bile ducts can be caused by cholelithiasis and cholecystitis, primary sclerosing cholangitis, postsurgical strictures, neoplasms of the pancreatic head and biliary tract, and pancreatitis. Initial imaging of the right upper quadrant can be done with either computed tomography or ultrasound scanning. Further work-up should be directed by the outcome of initial laboratory values and abdominal imaging.

Scleral icterus is more sensitive than jaundice for the detection of hyperbilirubinemia because of the high concentration of elastin in the sclera, which has a high affinity for bilirubin. Courvoisier's sign is painless enlargement of the gallbladder that represents extrinsic compression of the biliary tree; however, it is present in less than a third

of patients with biliary obstruction. The classic diagnosis associated with painless jaundice is pancreatic carcinoma. Excessive beta-carotene ingestion does not cause scleral icterus. Lack of scleral icterus can clinically differentiate pseudo-jaundice caused by beta-carotene from jaundice. Cholestatic jaundice can also present with generalized pruritis as the primary complaint.

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1. O'Regan D, Tait P. Imaging of the jaundiced patient. *Hosp Med* 2005;66(1):17–22.
2. Roche SP, Kobos R. Jaundice in the adult patient. *Am Fam Physician* 2004;69(2):299–304.

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CASE 18 | Pleuritic Chest Pain in a Young Adult Male

Answer: D

Diagnosis: Acute pericarditis

Discussion: The ECG is typical of acute myopericarditis with pericardial effusion manifested by electrical alternans. The rhythm strip demonstrates electrical alternans with alternating QRS complex amplitudes. The ECG demonstrates significant, diffuse ST segment elevation with a concave morphology; additionally, PR segment depression is seen in most leads with ST segment elevation. Lead aVR demonstrates reciprocal PR segment elevation.

Acute pericarditis produces diffuse inflammation of the pericardium and superficial epicardium. Numerous etiologies are encountered in the patient with acute myopericarditis, including infectious, inflammatory, toxicologic, and rheumatologic causes. The ECG can demonstrate significant findings in patients with acute pericarditis, including ST segment elevation, T wave inversion, and PR segment abnormalities. These changes result from endocardial inflammation; it is important to realize that the pericardium is electrically silent. Because of involvement of the pericardium and endocardium, pericarditis is most appropriately termed "myopericarditis."

The ECG changes caused by pericarditis evolve through four classic stages. The first stage is characterized by ST segment elevation, which is followed by resolution of the elevation in the second stage. The third stage occurs with T wave inversion followed by normalization of all such changes and a return to the baseline ECG in stage four. The temporal evolution of these electrocardiographic stages occurs in a very unpredictable fashion – stages one through

three are seen over hours to days, while stage four may not be reached for several weeks. Furthermore, patients may not manifest all characteristic ECG features.

ST segment elevation seen in patients with stage one pericarditis is usually less than 5 mm in height, observed in numerous leads, and characterized by a concavity to its initial upsloping portion. The ST segment elevation is most often seen in multiple leads, although it may be limited to a specific anatomic segment. PR segment depression associated with pericarditis perhaps is the most helpful feature in arriving at the correct electrocardiographic diagnosis; such a finding has been described as "almost diagnostic" for acute pericarditis. Reciprocal PR segment elevation is seen in lead aVR and is usually very helpful in the diagnosis.

Pericardial effusion may also be seen in patients with pericarditis; the presence of the effusion may affect the electrocardiographic signal noted on the ECG. These findings include widespread low voltage (resulting from increased resistance to injury current flow with the accumulated fluid) and electrical alternans (a beat-to-beat alteration in QRS complex size due to shifting fluid in the pericardium).

Further reading

1. Chan T, Brady WJ, Pollack M. Electrocardiographic manifestations: acute myopericarditis. *J Emerg Med* 1999;17:865–72.
2. Lange RA, Hillis LD. Clinical practice. Acute pericarditis. *N Engl J Med* 2004;351(21):2195–202.

as amyloidosis and metastatic carcinoma. Cholestatic diseases include graft-versus-host disease, primary biliary cirrhosis, and drugs such as erythromycin and chlorpromazine.

Extrinsic obstruction of the bile ducts can be caused by cholelithiasis and cholecystitis, primary sclerosing cholangitis, postsurgical strictures, neoplasms of the pancreatic head and biliary tract, and pancreatitis. Initial imaging of the right upper quadrant can be done with either computed tomography or ultrasound scanning. Further work-up should be directed by the outcome of initial laboratory values and abdominal imaging.

Scleral icterus is more sensitive than jaundice for the detection of hyperbilirubinemia because of the high concentration of elastin in the sclera, which has a high affinity for bilirubin. Courvoisier's sign is painless enlargement of the gallbladder that represents extrinsic compression of the biliary tree; however, it is present in less than a third

of patients with biliary obstruction. The classic diagnosis associated with painless jaundice is pancreatic carcinoma. Excessive beta-carotene ingestion does not cause scleral icterus. Lack of scleral icterus can clinically differentiate pseudo-jaundice caused by beta-carotene from jaundice. Cholestatic jaundice can also present with generalized pruritis as the primary complaint.

Further reading

1. O'Regan D, Tait P. Imaging of the jaundiced patient. *Hosp Med* 2005;66(1):17–22.
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CASE 19 | Exposed During a Blizzard

Answer: B

Diagnosis: Frostbite

Discussion: Frostbite is a cold-related injury that is due to the freezing of tissues when exposed to temperatures at or below the freezing point of intact skin. As the temperature to the skin drops, blood flow diminishes, ice crystals form, osmotic disequilibrium occurs, cellular dehydration develops, and cellular wall integrity becomes compromised. The end result is cellular death, capillary damage, and a vigorous local neutrophilic response.

Initial management should first be directed toward assessing core body temperature and hydration. Most patients will benefit from intravenous fluid administration as some degree of dehydration is typically seen, particularly among hypothermic patients or those who have experienced cold insult at high altitude.

After initial stabilization, rapid rewarming of the afflicted extremity is of paramount importance. In-field rewarming should only be attempted if refreezing and weight-bearing is not anticipated; prompt hospital care is preferred. Taking a warm water bath with chlorhexidine at temperatures between 40°C and 42°C for approximately 30–45 minutes is recommended. Utilizing water at lower temperatures results in slower and potentially incomplete rewarming, which worsens the outcome; utilizing water at higher temperatures risks the development of thermal burns. As extremity reperfusion begins, severe pain can be expected, and opioid analgesics are typically required. Dry air rewarming, especially over a camp fire, is discouraged because of the possibility of thermal injury. Massaging the frostbitten extremity should be avoided as it may result in further tissue damage.

After rewarming, attention is directed toward wound care and pain control. Wounds should be wrapped in sterile gauze after application of topical aloe vera. Aloe vera is an inhibitor of thromboxane, which is thought to play a large role in tissue loss. Ibuprofen should also be given because of its ability to inhibit prostaglandin synthesis. Tetanus immunization status should be assessed,

and the patient should avoid smoking and nicotine to avoid further peripheral vasoconstriction.

Controversy continues to exist in regard to the management of blisters. Clear vesicles and bullae are rich in thromboxane, which is thought to increase tissue loss. Proponents have advocated debridement as a means to remove thromboxane and allow for direct application of aloe vera, while others suggest that an intact epidermal layer helps protect re-epithelialization.

Surgical management of frostbite injuries should be delayed. There are three zones of injury: (1) the distal zone, which progresses to dry gangrene and eventually requires amputation; (2) the proximal zone, which heals without intervention; (3) the intermediate zone, which has the potential for salvage. Treatment and wound care are directed toward this zone. Complications may occur that require surgical intervention (i.e., compartment syndrome or gas gangrene), but the available evidence does not support early debridement; in fact, it has been shown to worsen outcome.

Antithrombotic therapy has been shown to be of benefit in several studies. Thrombosis of the microvasculature is frequent after rewarming and may contribute to tissue loss. Tissue plasminogen activator therapy has been directed toward reversing this thrombosis in patients with impaired perfusion. The use of technetium-99m “triple-phase” scanning is currently under investigation as a technique to access perfusion.

Further reading

1. Imray C, Grieve C, Dhillon S, et al. Cold damage to the extremities: frostbite and non-freezing cold injuries. *Postgrad Med J* 2009;85:481–8.
2. Jurkovich GJ. Environmental cold induced injury. *Surg Clin North Am* 2007;87:247–67.
3. Biem J, Koehncke N, Classen D, Dosman J. Out of the cold: management of hypothermia and frostbite. *CMAJ* 2003;168:305–11.

CASE 20 | FAST Evaluation of a Trauma Patient

Answer: E

Diagnosis: Intraperitoneal free fluid (i.e., blood)

Discussion: The focused assessment with sonography in trauma (FAST) evaluates for free fluid in the potential spaces of the trunk, detecting abnormal collections of fluid as they will be found in a supine patient. The potential spaces that are evaluated in the right upper quadrant

(RUQ) and left upper quadrant (LUQ) are the pleural, subphrenic, and perirenal. The perirenal space is usually referred to as the hepatorenal or Morison’s pouch in the RUQ, and the splenorenal space in the LUQ. The paracolic gutters are inferior extensions of the perirenal spaces; some emergency sonographers advocate evaluation of these areas as part of the FAST. The pericardial space is

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Figure 20.1 RUQ ultrasound showing the kidney (K), liver (L) and Morison's pouch (between the arrowheads).

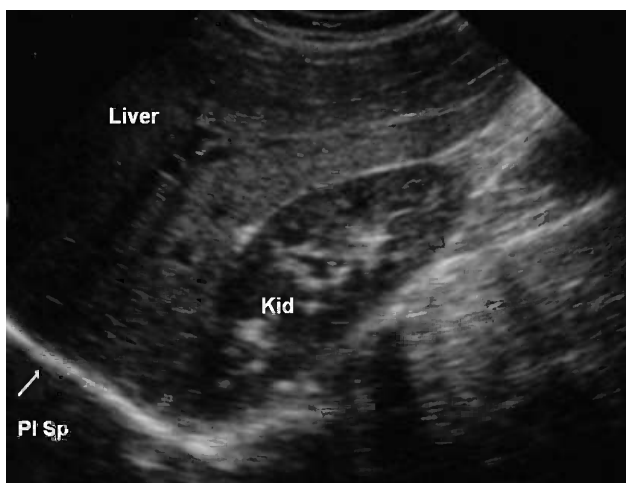


Figure 20.2 Normal RUQ view. The arrow indicates the diaphragm. Kid, kidney; PI Sp, pleural space.

evaluated from a subxiphoid (or "subcostal") window. A parasternal view may be substituted if the patient has a protuberant abdomen or cannot tolerate compression of the transducer in the subxiphoid space. The final potential spaces to be evaluated are in the pelvis: the retrovesicular space in the male, and the rectouterine space, or pouch of Douglas, in the female. These are the most dependent spaces in the entire abdominal cavity. However, in most cases of blunt trauma, the sources of peritoneal blood are the solid organs and vascular structures of the upper abdomen, which will fill the dependent spaces of the upper abdomen before reaching the level of the pelvic brim and draining into the pelvis. For this reason, blood is much more frequently found in upper abdominal locations than in the pelvis in the supine patient.

Figure 20.1 shows the RUQ view from this case. Figure 20.2 shows a normal RUQ demonstrating all three of the spaces discussed above. The diaphragm (arrow in Figure 20.2) divides the pleural space from the subphrenic space. Morison's pouch is seen between the liver and kidney. In

the absence of abnormal collections of free fluid, Morison's pouch and the diaphragm are strongly echogenic, therefore appearing white on the image. In Figure 20.1, the dark anechoic stripe (arrowheads) in Morison's pouch is caused by fluid in this potential space. Similarly, free fluid in the pleural or subphrenic space would appear as an anechoic stripe. In more than 50% of cases of positive FAST examinations, free fluid is seen in Morison's pouch. Some authorities have made the *a priori* estimate that a small stripe in Morison's pouch represents about 250 mL intraperitoneal fluid. However, accurate operative assessment of intraperitoneal free fluid volumes is not possible. Studies using diagnostic peritoneal lavage as a model suggest that the volume needed to be reliably detected in Morison's pouch is closer to 650 mL free fluid. Placing the patient in the Trendelenburg position reduces this volume by 33%, to about 450 mL.

In the case of this trauma patient, the sonographic evidence of hemoperitoneum with hemodynamic instability mandates immediate transfer to the operating room for exploratory laparotomy. Although computed tomography (CT) scanning is superior to sonography in identifying solid organ injury, it has several disadvantages. These include the removal of the patient from the resuscitation area, the use of intravenous contrast agents, the commitment of significant manpower resources, and the expense. In this case, it would also delay the definitive care of a patient already in hemorrhagic shock. The transfusion of blood products is a critical action, but allowing the patient to remain in the emergency department for serial examinations is not a viable option because of the strong evidence for a life-threatening injury. Finally, diagnostic peritoneal lavage in this case is not warranted since the FAST examination has already demonstrated the presence of intraperitoneal fluid.

Thoracic views can also be incorporated into the FAST examination to evaluate for pneumothorax. This *extended* version of the examination has become known as the "e-FAST." A high-frequency, linear array transducer is placed longitudinally over the anterior thorax several centimeters lateral to the sternal border. The ribs are identified as hyperechoic structures that cast a shadow distally. Between the ribs are the intercostal muscles, and just beneath this level is the hyperechoic (white) pleural interface. In the absence of a pneumothorax, a shimmering artifact, known as a sliding lung sign, is seen at the parietal interface with each respiration (Figure 20.3). This phenomenon, caused by numerous individual artifacts from air pockets in the alveoli, disappears if a pneumothorax is present. The sensitivity of this technique at identifying a pneumothorax is superior to that of a supine, anteroposterior chest X-ray. M-mode imaging can be performed to exaggerate the appearance of the sliding lung sign. Figure 20.4 demonstrates an M-mode tracing of normal lung. The bottom portion of the image shows a



Figure 20.3 Longitudinal, parasternal view of the anterior chest showing the pleural interface (arrow) and ribs (arrowheads). In real-time imaging of a normal lung, a sliding lung sign can be seen at the pleural interface. This sign disappears in the presence of a pneumothorax.

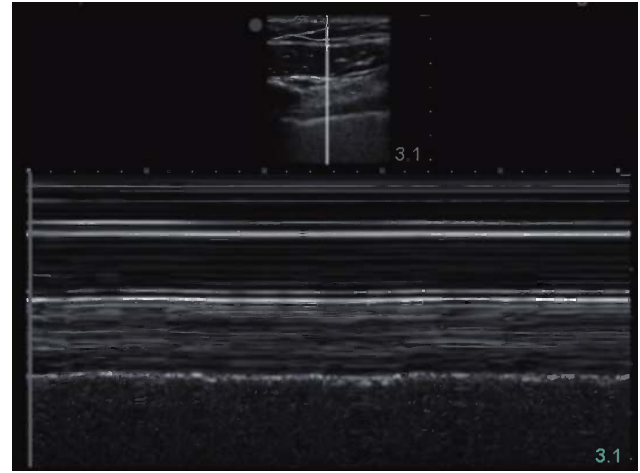


Figure 20.4 M-mode tracing of a normal sliding lung sign (see text).

granular consistency known as the “beach” sign. In the presence of a pneumothorax, the M-mode tracing at this level would show multiple horizontal lines similar to those of the upper portion of the image, known as the “stratosphere” sign.

Further reading

1. Rose J. Ultrasound in abdominal trauma. *Emerg Med Clin North Am* 2004;22:581–99.

2. Kirkpatrick AW, Sirois M, Laupland KB, et al. Handheld thoracic sonography for detecting post-traumatic pneumothoraces: the extended focused assessment with sonography for trauma (EFAST). *J Trauma* 2004;57:288–95.
3. Abrams BJ, Sukumvanich P, Seibel R, et al. Ultrasound for the detection of intraperitoneal fluid: the role of Trendelenburg positioning. *Am J Emerg Med* 1999;17(2):117–20.

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CASE 21 | Chest Pain with Sudden Cardiac Death

Answer: D

Diagnosis: Polymorphic ventricular tachycardia and QT prolongation

Discussion: The rhythm strip demonstrates polymorphic ventricular tachycardia (PVT) with a polymorphous QRS complex; note the variation in the morphology and amplitude of the QRS complex – it appears to twist around a fixed point. This rhythm is an example of a specific type of PVT, torsade de pointes (TdP). The ECG demonstrates normal sinus rhythm with a prolonged QT interval and T wave inversions in leads II, III, aVF, V2, V3, V4, V5, and V6 – consistent with an acute coronary syndrome.

Long QT syndrome (LQTS) is an electrophysiologic cardiac disorder in which the repolarization phase of the

ventricular action potential is lengthened. It is manifested as a prolongation of the QT interval on the surface ECG and is clinically significant in that it can precipitate the development of PVT and sudden cardiac death. Congenital and acquired forms of LQTS are encountered, the former due to abnormalities in transmembrane ion channels and the latter due to multiple causes including medications and toxins, electrolyte imbalance, bradycardia, central nervous system events, acute coronary syndrome, autonomic neuropathy, and human immunodeficiency virus.

Patients with LQTS may present with a variety of symptoms, ranging from mild dizziness to syncope or, in the extreme, sudden cardiac death – likely resulting from TdP, a form of PVT that occurs in the setting of QT interval prolongation. TdP is recognized on a surface ECG as



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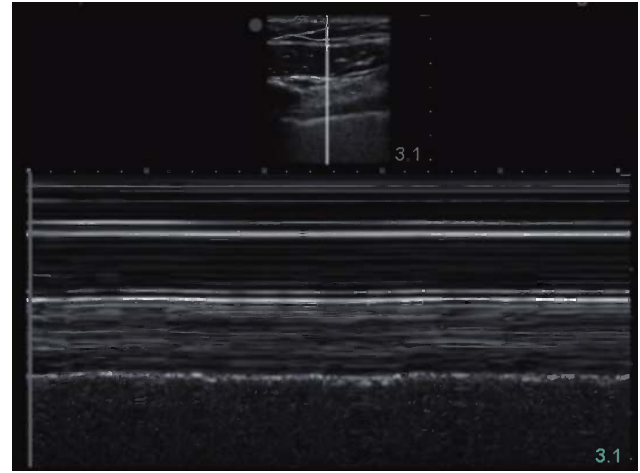


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Patients with LQTS may present with a variety of symptoms, ranging from mild dizziness to syncope or, in the extreme, sudden cardiac death – likely resulting from TdP, a form of PVT that occurs in the setting of QT interval prolongation. TdP is recognized on a surface ECG as

a progressive, complete 180 degree twisting of the QRS complexes around an imaginary baseline. Because TdP is usually limited to 10–12 beats and terminates spontaneously, patients may complain of only mild dizziness or may even be asymptomatic. Syncope and sudden cardiac death can result from rapidly recurring or sustained episodes of TdP that ultimately degenerate into ventricular fibrillation. **Clinical Presentation:** Patients with LQTS may present to the ED with a variety of symptoms, ranging from mild dizziness to syncope or, in the extreme, sudden cardiac death. These symptoms are all due to torsades de pointes, a form of polymorphic ventricular tachycardia that occurs in the setting of QT interval prolongation. It is recognized on a surface electrocardiogram as progressive, complete 180 degree twisting of the QRS complexes around an imaginary baseline. Because torsades is usually limited to 10 to 12 beats and terminates spontaneously, patients may complain of only mild dizziness or may even be asymptomatic. Syncope and sudden cardiac death can result from rapidly recurring or sustained episodes of torsades which ultimately degenerate into ventricular fibrillation.

The diagnosis of LQTS is made via the combination of symptoms, family history, and electrocardiographic abnormality, T wave alternans, and U waves. A QT interval that is prolonged, usually greater than 450 milliseconds, is considered abnormal and potentially suggestive of the syndrome. For example, a QTc interval greater than 440 milliseconds places a patient at a 2–3-fold higher risk for sudden death than does a QTc interval of less than 440 milliseconds. The QTc interval may be calculated using the Bazett formula (Box 21.1) or via comparative measurements to the accompanying RR interval – a QT interval that is less than one-half the accompanying RR interval is considered normal.

The management of the patient with LQTS involves immediate therapy of active dysrhythmia followed by recognition of the syndrome; further management of LQTS then involves a correction of any precipitating issues, such as electrolyte abnormality, bradycardia, adverse effect of medication, acute coronary ischemia, etc.

Box 21.1 Determination of the corrected QT interval

1 Calculated determination

Bazett formula – calculates the QT interval corrected for heart rate by dividing the QT interval by the square root of the RR interval

$$QT_c = QT / (RR)^{0.5}$$

2 Rapid bedside determination

For rates between 60 and 100 beats per minute, the QT interval may be rapidly and reliably corrected for the particular rate. If the QT interval is less than one-half the accompanying RR interval, the QT interval is appropriate for that rate

Emergent treatment involves electrical cardioversion or defibrillation for the patient presenting in sustained TdP. Treatment is then needed to prevent the recurrence of TdP, which may involve correcting any electrolyte abnormality, removing any offending agent possibly prolonging the QT interval, and instituting temporary transvenous overdrive cardiac pacing if necessary. The acquired forms of LQTS generally do not require any long-term treatment as correction of the offending issue is usually adequate. In patients with acquired LQTS secondary to bradycardia, implantation of a permanent pacemaker is usually effective. Long-term treatment of congenital LQTS, however, is essential to prevent recurrences of TdP, including beta-adrenergic blocking agents and an implantable pacemaker–cardioverter–defibrillator.

Further reading

1. Schwartz PJ, Moss AJ, Vincent GM, et al. Diagnostic criteria for the long QT syndrome: an update. *Circulation* 1993;88:782–4.
2. Schwartz PJ. Idiopathic long QT syndrome: progress and questions. *Am Heart J* 1985;2:399–411.

CASE 22 | Wrist “Sprain” in a Child

Answer: E

Diagnosis: Buckle fracture

Discussion: This patient has a buckle fracture (also known as a “torus” fracture) of the distal radius. A cortical bulge or “buckling” occurring at the metaphysis of a long bone is diagnostic of this type of fracture (Figure 22.1). Lateral films often show signs of buckling better than anteroposterior views. Both cortical margins are

affected, but a discrete fracture line or trabecular disruption is absent. This is an important distinction from the “greenstick” fracture, which does include cortex disruption on the tension side of the bone. Although similar, the greenstick fracture carries a higher risk for progression of angulation and refracture. The treatment is different for greenstick and buckle fractures. On occasion, radiographic signs of a fracture are not evident on the initial

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1. Schwartz PJ, Moss AJ, Vincent GM, et al. Diagnostic criteria for the long QT syndrome: an update. *Circulation* 1993;88:782–4.
2. Schwartz PJ. Idiopathic long QT syndrome: progress and questions. *Am Heart J* 1985;2:399–411.

CASE 22 | Wrist “Sprain” in a Child

Answer: E

Diagnosis: Buckle fracture

Discussion: This patient has a buckle fracture (also known as a “torus” fracture) of the distal radius. A cortical bulge or “buckling” occurring at the metaphysis of a long bone is diagnostic of this type of fracture (Figure 22.1). Lateral films often show signs of buckling better than anteroposterior views. Both cortical margins are

affected, but a discrete fracture line or trabecular disruption is absent. This is an important distinction from the “greenstick” fracture, which does include cortex disruption on the tension side of the bone. Although similar, the greenstick fracture carries a higher risk for progression of angulation and refracture. The treatment is different for greenstick and buckle fractures. On occasion, radiographic signs of a fracture are not evident on the initial

X-ray. A second set of X-rays 2–3 weeks after the trauma should be considered in children with continued pain. It is important to remember that sprains are rare in children, and children should not typically complain about 3 weeks of pain following minor injuries.

The etiology of buckle fractures is typically a fall on an outstretched hand (“FOOSH”) injury. Buckle fractures are compression fractures of long bones and typically occur in children. Because of the elasticity of developing bones, the dorsal aspect of the cortex can be disrupted by the compression injury, while the volar aspect of the cortex is stretched but does not break. The radius is typically the only bone involved; however, the ulna can also be injured.

The treatment of buckle fractures is immobilization to reduce pain and allow the fracture to heal. This has traditionally been placement of an immobilizing cast for a period of 2–3 weeks. Some also believe that the casting should cross the elbow to prevent angulation deformity during healing. However, other authorities have advocated splinting and ace bandages, as these treatments have not demonstrated adverse outcomes and carry some advantage over casting with regard to functionality during treatment. Analgesics, such as ibuprofen, can be administered for pain relief.

Further reading

1. Randsborg P, Silversten EA. Distal radius fractures in children: substantial difference in stability between buckle and greenstick fractures. *Acta Orthoped* 2009;80(5):585–9.
2. Plint AC, Perry JJ, Correll R, et al. A randomized, controlled trial of removable splinting versus casting for wrist buckle fractures in children. *Pediatrics* 2006;117:691–7.



Figure 22.1 The case X-rays with arrows pointing to the subtle buckle fracture.

3. West S, Andrew J, Bebbington A, et al. Buckle fractures of the distal radius are safely treated in a soft bandage: a randomized prospective trial of bandage versus plaster cast. *J Pediatr Orthop* 2005;25(3):322–5.

Acknowledgement: We thank Craig S. Brummer, MD for his contribution to this case in the previous edition.

CASE 23 | Acute Eye Pain and Blurred Vision in an Elderly Female

Answer: C

Diagnosis: Acute angle closure glaucoma

Discussion: Acute angle closure glaucoma is much rarer than open angle glaucoma. It generally affects patients in their sixth to seventh decade of life and is slightly more common in females. Acute angle closure glaucoma is characterized by a rapid rise in intraocular pressure. The rapid increase in pressure causes conjunctival injection and corneal edema, as shown in the case photo. The major factor responsible for precipitating an angle closure attack is prolonged periods of midpupillary dilation. Acute

angle closure attacks tend to occur after prolonged periods in dim illumination. Attacks also occur after periods of severe stress due to adrenergic stimulation and dilation of the pupil. Both adrenergic agonists and anticholinergic agents, either topical or systemic, are also capable of precipitating an acute attack. The intraocular pressure rises when the iris occludes the trabecular meshwork preventing aqueous outflow. Severe pressure elevations can occur within 1 hour, resulting in permanent damage.

Initial management of acute angle closure glaucoma involves pharmacologic lowering of the intraocular

X-ray. A second set of X-rays 2–3 weeks after the trauma should be considered in children with continued pain. It is important to remember that sprains are rare in children, and children should not typically complain about 3 weeks of pain following minor injuries.

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Initial management of acute angle closure glaucoma involves pharmacologic lowering of the intraocular

pressure by inhibiting aqueous production. A careful medical history should be taken, specifically for asthma, chronic obstructive pulmonary disease, congestive heart failure, renal failure, and drug allergies. If not contraindicated, a topical beta-blocker such as timolol or levobunolol, 0.5%, should be instilled, along with topical brimonidine 0.15%. A carbonic anhydrase inhibitor such as acetazolamide, two 250mg tablets, should be given orally, or 500mg given intravenously. Severe cases may require intravenous mannitol, in doses of 1–2g/kg infused over 45 minutes. Vital signs should be monitored closely when giving mannitol. The intraocular pressure should be rechecked within 1 hour. Ophthalmologic consultation is necessary for patients with acute angle closure

glaucoma since the definitive treatment is a peripheral laser iridotomy.

Further reading

1. Dargin JM, Lowenstein RA. The painful eye. *Emerg Med Clin North Am* 2008;26:199–216.
2. Lam SC, Tham CC, Lai JS, Leung DY. Current approaches to the management of acute primary angle closure. *Cur Opin Ophthalmol* 2007;18:146–51.
3. Saw SM, Gazzard G, Friedman DS. Interventions for angle-closure glaucoma: an evidence-based update. *Ophthalmology* 2003;110:1869–78.

CASE 24 | Heel Pain Following a Fall

Answer: B

Diagnosis: Displaced calcaneus fracture

Discussion: Calcaneus fractures are the most common tarsal bone fractures. A significant amount of force must be delivered to cause a calcaneus fracture. Calcaneus fractures are usually a result of an axial load, commonly occurring after a fall from a significant height, landing in a standing position, directly on the calcaneus. They are part of the spectrum of axial loading injuries to the lower extremity, which can include calcaneus fractures, pilon (plafond) fractures, tibial plateau fractures, femur fractures, and fracture–dislocation of the hip. Greater than 20% of calcaneus fractures have accompanying lumbar spine compression fractures. Therefore, all patients with calcaneus fractures should have screening lumbar spine radiographs.

Foot radiographs to evaluate for calcaneus fractures can be difficult to interpret. Subtle, nondisplaced calcaneus fractures are often missed on a routine foot series. Close examination of the lateral view for changes in the cortical and trabecular bone often reveals subtle fractures. Increased density of markings in the trabecular architecture may be the only sign of a compression fracture. Dedicated axial views of the calcaneus, obtained with the X-ray beam projected perpendicular to the long axis of the calcaneus, can improve sensitivity. Boehler's angle should be measured and is determined by the angle formed by two straight lines: one drawn along the superior surface of the posterior tuberosity of the calcaneus to the superior tip of the subtalar articular surface; the other connecting the superior tip of the subtalar articular surface with the apex of the anterior surface of the calcaneus (Figure 24.1). The angle is normally between 20

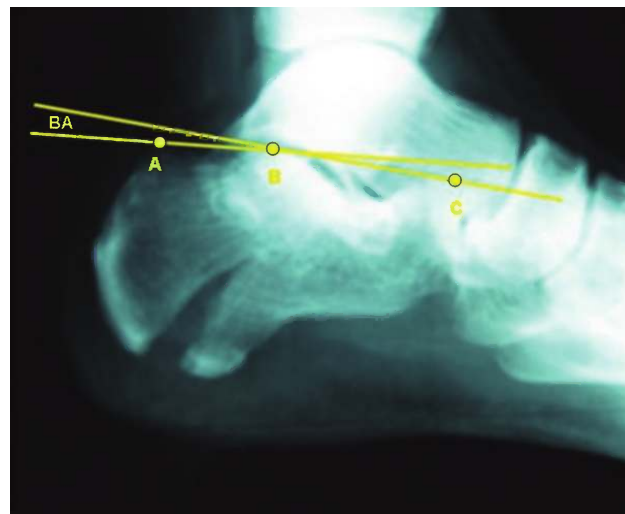


Figure 24.1 Boehler's angle measurement from the clinical case. Two lines are drawn: one from the posterior calcaneal tubercle (A) to the most superior point of the calcaneus (B), the other from the anterior calcaneal tubercle (C) to the most superior part of the calcaneus (B). Boehler's angle (BA) represents the acute angle of intersection between these two lines and is normally between 20 and 40 degrees. An angle, such as in this case, of less than 20 degrees suggests a calcaneal fracture.

and 40 degrees. The majority of calcaneus fractures have a decrease in Boehler's angle to less than 20 degrees.

Computed tomography (CT) scanning can help in pre-operative management of complex calcaneus fractures, to differentiate extra-articular from intra-articular fractures. CT scanning should also be considered to evaluate for an occult calcaneus fracture in patients with normal

pressure by inhibiting aqueous production. A careful medical history should be taken, specifically for asthma, chronic obstructive pulmonary disease, congestive heart failure, renal failure, and drug allergies. If not contraindicated, a topical beta-blocker such as timolol or levobunolol, 0.5%, should be instilled, along with topical brimonidine 0.15%. A carbonic anhydrase inhibitor such as acetazolamide, two 250mg tablets, should be given orally, or 500mg given intravenously. Severe cases may require intravenous mannitol, in doses of 1–2g/kg infused over 45 minutes. Vital signs should be monitored closely when giving mannitol. The intraocular pressure should be rechecked within 1 hour. Ophthalmologic consultation is necessary for patients with acute angle closure

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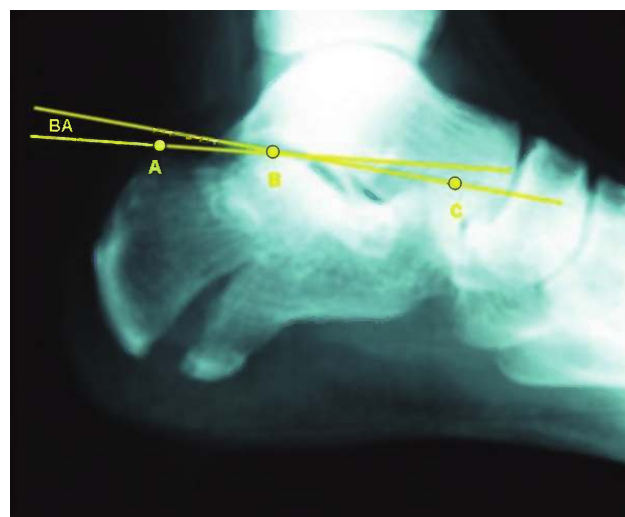


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radiographs who have ongoing pain and an inability to ambulate.

In confirmed fractures, a careful search for evidence of open fracture must be performed. Nondisplaced fractures can be treated with immobilization and orthopedic follow-up. Fractures displaced more than 3mm, comminuted fractures, and intra-articular fractures (extending into the subtalar joint) need operative management for open reduction and internal fixation of the fracture fragments. The postinjury course can be complicated by compartment syndrome (suggested by extreme swelling at the plantar arch), nonunion, chronic pain, and arthritis of the subtalar joint. Management is often surgical, and both

open and percutaneous techniques may be employed for repair.

Further reading

1. Marx RC, Mizel MS. What's new in foot and ankle surgery? *J Bone Joint Surg Am* 2010;92:512–23.
2. Germann CA, Perron AD, Miller MD, et al. Orthopedic pitfalls in the ED: calcaneal fractures. *Am J Emerg Med* 2004;22:607–11.

Acknowledgement: We thank David F. Gaieski, MD for his contribution to this case in the previous edition.

CASE 25 | Confluent Rash on a Child

Answer: C

Diagnosis: Erythema multiforme (minor)

Discussion: Erythema multiforme (EM) is an acute and typically self-limited hypersensitivity reaction that manifests as a diffuse eruption with characteristic lesions. The lesions are usually symmetric, involve the palms of the hands and the soles of the feet, and predominate on the extensor surfaces of the upper and lower extremities. Although these are characteristic locations, lesions can be found anywhere on the body. The rash of EM can look macular, urticarial, or vesicobullous, but the prototypical lesion is a target lesion with a dusky center. Often the rash changes from one form of lesion to another as the disease progresses. The rash itself generally lasts for at least 1 week, but can last up to 6 weeks. Patients are often otherwise asymptomatic, although they can also have itching associated with the lesions or involvement of the oral mucosa.

The causes of EM in children are most commonly infectious, whereas in adults the condition is much more frequently related to drug reaction or malignancy. The most common infectious agent attributed to EM is herpes simplex virus. The differential diagnosis of EM includes pemphigus, bullous pemphigoid, urticaria, or other viral exanthems. Treatment for EM minor may involve cessation of inciting agents but is mainly supportive, including antihistamines and/or nonsteroidal anti-inflammatory drugs. Systemic glucocorticoids are sometimes used, although there are no randomized trials showing clear benefit. Recurrent cases may be treated with antiviral

medications including acyclovir, valacyclovir, or famciclovir.

Classically, EM has been thought to be part of continuum of more serious illness such as Stevens–Johnson syndrome (SJS) and toxic epidermal necrolysis (TEN), but increasingly EM is being considered a distinct diagnosis, albeit with a similar pathophysiology to that of the more severe syndromes. It is important on physical examination to evaluate mucosal surfaces to differentiate between EM and SJS or TEN. EM involves the skin and only one other mucosal surface, usually the mouth. In contrast, SJS involves the eye, oral cavity, genital mucosa, upper airway, or esophagus. SJS and TEN are much more serious conditions with significantly higher mortality rates. Treatment for these conditions is frequently compared to burn care, and hospital admission is required. It is important to keep these other entities in mind even in cases of EM because patients and their families should be discharged with clear instructions about signs to look for that may indicate progression to more serious disease.

Further reading

1. Lamoreux MR, Sternbach MR, Hsu WT. Erythema multiforme. *Am Fam Physician* 2006;74(11):1883–8.
2. William PM, Konklin RJ. Erythema multiforme: a review and contrast from Stevens–Johnson syndrome/toxic epidermal necrolysis. *Dent Clin North Am* 2005;49(1):67–76.

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CASE 26 | Bradycardia Following an Herbal Ingestion

Answer: E

Diagnosis: *Aconitum delphinifolium* (monkshood) poisoning

Discussion: The use of herbal products has dramatically increased over the past decade, driving physicians to become educated in regards to potential herbal complications and drug interactions. Studies have documented that approximately one in every five patients presenting to the emergency department uses some type of herbal preparation.

Plants that contain aconitine include *Aconitum napellus* (monkshood), *A. vulparia* (wolfsbane), *A. carmichaeli* (Chuan Wu) and *A. kusnezoffii* (Cao Wu). Members of this plant genus grow throughout the world. Aconitine exposures are commonly associated with the overzealous consumption of certain herbal preparations. Although a number of fatal poisonings have been reported, aconitine is still readily available at many nutrition or herbal medicine stores.

These plants flowers, which are commonly purple, form a hood-like structure, hence the name “monkshood.” All parts of this plant are potentially poisonous. Aconitine appears to increase sodium entry into muscle, nerve, baroreceptors, and Purkinje fibers to produce a positive inotropic effect, enhanced vagal tone, neurotoxicity, increased automaticity, and torsade de pointes. Bifascicular

ventricular tachycardia, a dysrhythmia most frequently associated with digitalis toxicity, has also been reported in patients poisoned with aconite.

Following exposure, symptoms have been reported to occur between 3 minutes and 2 hours, with a median of 30 minutes. Symptoms may persist for up to 30 hours. Neurologic complaints include initial visual impairment, dizziness, limb paresthesias, weakness, ataxia, and coma. Chest discomfort, dyspnea, tachycardia, bradycardia, ectopic beats, supraventricular tachycardia, bundle branch block, intermittent bigeminy, ventricular tachycardia, ventricular fibrillation, and asystole have all been described.

Treatment is primarily supportive. The paramount concern is the management of lethal arrhythmias. Symptomatic bradydysrhythmias may respond to atropine administration. Ventricular tachycardia has been reported to be refractory to pharmacologic therapy.

Further reading

1. Froberg B, Ibrahim D, Furbee RB. Plant poisoning. *Emerg Med Clin North Am* 2007;25(2):375–433.
2. Guha S, Dawn B, Dutta G, et al. Bradycardia, reversible panconduction defect and syncope following self-medication with a homeopathic medicine. *Cardiology* 1999;91(4):268–71.

CASE 27 | A Pain-free Adult with Persistent T Wave Abnormalities

Answer: D

Diagnosis: Wellens’ syndrome (left anterior descending coronary T wave syndrome)

Discussion: The ECG demonstrated biphasic T wave inversions in the anterior, inferior, and lateral leads; the T waves were deeply inverted in leads V2–V5, and biphasic in leads V2 and V3. The patient was admitted to the hospital, where cardiac catheterization revealed a near-complete proximal left anterior descending (LAD) coronary artery lesion; this lesion was stented with adequate flow after the stent placement.

An important subgroup of patients with acute coronary syndrome (ACS) present with significantly abnormal T wave inversions – either symmetric, deeply inverted T waves or biphasic T waves of the precordial leads. These

patients are likely presenting with Wellens’ syndrome. This syndrome was initially described in a group of patients admitted with ACS and short-term adverse outcome, including extensive anterior ST segment elevation acute myocardial infarction, and death. Additional investigation has revealed the following characteristics of Wellens’ syndrome: two morphologies of T wave abnormalities, as noted above; a persistence of T wave abnormalities in the pain-free state; an absence of ECG and biochemical evidence of myocardial infarction; association of critical proximal LAD coronary artery stenosis; and a natural history of anterior wall ST elevation myocardial infarction.

Wellens’ T wave morphologies include two basic types. The more common variant is a deeply inverted T wave

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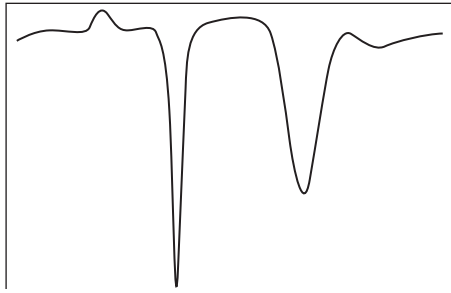


Figure 27.1 Deeply inverted T wave.

(Figure 27.1), seen in approximately 75% of patients, while the less commonly encountered form is the biphasic T wave (Figure 27.2).

Of note, the T wave abnormalities are encountered in patients with active chest pain and those pain-free individuals with recent chest discomfort. Importantly, patients presenting with potential Wellens' syndrome should be admitted to the hospital with consideration of coronary angiography. Exercise stress testing and other variants of such diagnostic testing should not be performed due to the risk of sudden syndrome progression with anterior wall infarction and/or sudden cardiac death.

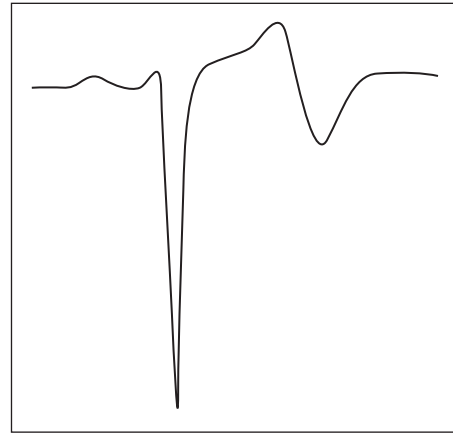


Figure 27.2 Biphasic T wave (upright and inverted components).

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1. Rhinehardt J, Brady WJ, Perron AD, Mattu A. Electrocardiographic manifestations of Wellens' syndrome. *Am J Emerg Med* 2002;20:638–43.
2. Atie J, Brugada P, Brugada J, et al. Clinical presentation and prognosis of left main coronary artery disease in the 1980s. *Eur Heart J* 1991;12:495–502.

CASE 28 | Caustic Ingestion with Cardiotoxic Effects

Answer: B

Diagnosis: Fluoride toxicity

Discussion: In this case, the patient had ingested an unknown liquid substance. His initial symptoms of throat burning, emesis, difficulty with phonation, inability to manage secretions, and chest and abdominal pain were consistent with a caustic ingestion. A rapid bedside litmus paper test revealed that the substance had an acidic pH. An initial arterial blood gas revealed a metabolic acidosis with a compensatory respiratory alkalosis. The patient subsequently progressed to hypotension with electrocardiographic changes of both QRS complex widening and QT interval prolongation. For the astute clinician who considers the differential diagnosis of an acidic agent that produces metabolic acidosis, hypotension, and ECG abnormalities (QRS complex widening and QT interval prolongation), the diagnosis is readily determined to be hydrofluoric acid ingestion.

Hydrofluoric acid is utilized in many industrial settings for the production of integrated circuits, fluorides, plastics, germicides, and insecticides, and for the etching and cleaning of silicone, glass, metal, stone, and porcelain.

Hydrofluoric acid-containing products are sold as automotive cleaning products in local stores. Hydrofluoric acid rapidly corrodes and penetrates the skin and mucous membranes. Ingestion may result in local mucosal caustic effects, nausea, vomiting, abdominal pain, or hemorrhagic gastritis. Systemic electrolyte abnormalities may occur. The absorbed fluoride ions rapidly bind to the available calcium and magnesium ions, decreasing the body's levels of these divalent cations. Hyperkalemia often follows due to an efflux of potassium out of cells into the extracellular space.

This patient manifested progressive QT interval prolongation. Hydrofluoric acid causes QT interval prolongation by inducing hypomagnesemia and hypocalcemia. These events may place the patient at risk for polymorphic ventricular tachycardia or torsade de pointes.

All patients presenting with signs and symptoms consistent with hydrofluoric acid ingestion should be aggressively managed. The patient's airway should be assessed and adequate ventilation assured. If necessary, endotracheal intubation should be performed early before edema leads to airway obstruction. The patient should be placed

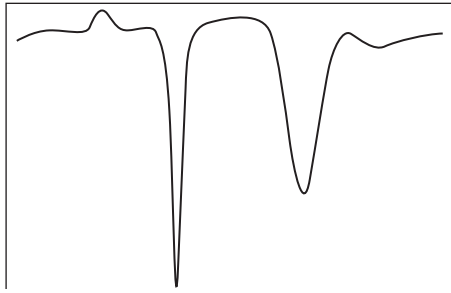


Figure 27.1 Deeply inverted T wave.

(Figure 27.1), seen in approximately 75% of patients, while the less commonly encountered form is the biphasic T wave (Figure 27.2).

Of note, the T wave abnormalities are encountered in patients with active chest pain and those pain-free individuals with recent chest discomfort. Importantly, patients presenting with potential Wellens' syndrome should be admitted to the hospital with consideration of coronary angiography. Exercise stress testing and other variants of such diagnostic testing should not be performed due to the risk of sudden syndrome progression with anterior wall infarction and/or sudden cardiac death.

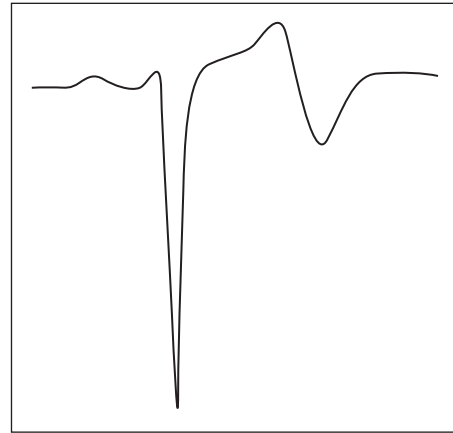


Figure 27.2 Biphasic T wave (upright and inverted components).

Further reading

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2. Atie J, Brugada P, Brugada J, et al. Clinical presentation and prognosis of left main coronary artery disease in the 1980s. *Eur Heart J* 1991;12:495–502.

CASE 28 | Caustic Ingestion with Cardiotoxic Effects

Answer: B

Diagnosis: Fluoride toxicity

Discussion: In this case, the patient had ingested an unknown liquid substance. His initial symptoms of throat burning, emesis, difficulty with phonation, inability to manage secretions, and chest and abdominal pain were consistent with a caustic ingestion. A rapid bedside litmus paper test revealed that the substance had an acidic pH. An initial arterial blood gas revealed a metabolic acidosis with a compensatory respiratory alkalosis. The patient subsequently progressed to hypotension with electrocardiographic changes of both QRS complex widening and QT interval prolongation. For the astute clinician who considers the differential diagnosis of an acidic agent that produces metabolic acidosis, hypotension, and ECG abnormalities (QRS complex widening and QT interval prolongation), the diagnosis is readily determined to be hydrofluoric acid ingestion.

Hydrofluoric acid is utilized in many industrial settings for the production of integrated circuits, fluorides, plastics, germicides, and insecticides, and for the etching and cleaning of silicone, glass, metal, stone, and porcelain.

Hydrofluoric acid-containing products are sold as automotive cleaning products in local stores. Hydrofluoric acid rapidly corrodes and penetrates the skin and mucous membranes. Ingestion may result in local mucosal caustic effects, nausea, vomiting, abdominal pain, or hemorrhagic gastritis. Systemic electrolyte abnormalities may occur. The absorbed fluoride ions rapidly bind to the available calcium and magnesium ions, decreasing the body's levels of these divalent cations. Hyperkalemia often follows due to an efflux of potassium out of cells into the extracellular space.

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All patients presenting with signs and symptoms consistent with hydrofluoric acid ingestion should be aggressively managed. The patient's airway should be assessed and adequate ventilation assured. If necessary, endotracheal intubation should be performed early before edema leads to airway obstruction. The patient should be placed

on continuous cardiac monitoring with pulse oximetry, and frequent neurologic checks should be made. The initial treatment of hypotension consists of intravenous fluids, followed by vasopressors as needed. The patient's pulmonary status should be monitored closely for clinical signs consistent with pulmonary aspiration. Activated charcoal, syrup of ipecac, and gastric lavage are absolutely contraindicated in patients who have ingested caustic agents. Serum electrolytes should be obtained hourly and include serial calcium, magnesium, and potassium levels. The clinician should obtain serial ECGs looking for signs of hypocalcemia (prolonged QTc interval) and hyperkalemia (peaked T waves). Aggressive replacement of calcium and magnesium will be needed to normalize serum levels. Fluoride-induced hyperkalemia has been reported to be difficult to reverse. Early aggressive therapy with glucose, insulin, and/or sodium bicarbonate may be effective.

Dermal hydrofluoric acid exposures are more commonly seen than ingestions and occur when household rust removers or tire cleaners contact the skin (concentrations range from 6% to 12%). These agents often cause delayed finger pain after liquid drips from the spray bottle onto unprotected hands during application of the product. The exposed dermal site may initially look quite

innocuous but still cause significant local and potentially systemic toxicity. Inhalational exposures can cause laryngeal, pharyngeal, or pulmonary edema. Ocular exposure can lead to extensive damage to the eye similar to other acids, with copious irrigation as the mainstay of treatment.

Symptomatic hand exposures can be treated with topical gels (25mL 10% calcium gluconate in 75mL of a water-soluble lubricant such as KY Jelly). In cases of refractory pain, case reports suggest that arterial catheterization (the radial artery for hand exposures) and infusion of 2% calcium gluconate over 36 hours may facilitate recovery and pain control.

Further reading

1. Capitani EM, Hirano ES, Zuim Ide S, et al. Finger burns caused by concentrated hydrofluoric acid, treated with intra-arterial calcium gluconate infusion: case report. *Sao Paulo Med J* 2009;127:379–81.
2. Holstege CP, Baer AB, Brady WJ. The electrocardiographic toxidrome: the ECG presentation of hydrofluoric acid ingestion. *Am J Emerg Med* 2005;23:171–6.
3. Bertolini JC. Hydrofluoric acid: a review of toxicity. *J Emerg Med* 1992;10:163–8.

CASE 29 | Chemical Eye Exposure

Answer: C

Diagnosis: Chemical injury to the eye

Discussion: Chemical injuries to the eye range from mild irritation to devastating destruction of the ocular surface resulting in visual impairment or even loss of the eye. Most chemical injuries affect young patients, with exposure occurring at home, in industrial or agricultural accidents, or in criminal assault. The offending chemical may be in the form of a solid, liquid, powder, or vapor. The severity of the injury depends on the offending agent, the surface area of contact, and the degree of penetration.

The most important step in the initial management of chemical injuries is immediate and copious irrigation of the ocular surface with lactated Ringer's solution or normal saline solution, even before testing vision. This may be facilitated using a topical anesthetic and handheld intravenous tubing or a Morgan lens. Irrigation should be continued for a minimum of 30 minutes until the conjunctival sac pH is neutral. The conjunctival pH can be easily checked with a urinary pH strip. Sweeping the conjunc-

tival fornices with a moistened cotton-tipped applicator for solid particles should be performed for a persistently elevated pH.

Alkali injuries occur most frequently and are the most devastating. These agents elevate the pH and readily penetrate the ocular tissues. Blanching of the conjunctiva indicates penetration, vascular ischemia, and necrosis, which are often the result of severe alkali injuries. On the other hand, acid injuries tend to remain confined to the surface of the eye and produce superficial damage.

Further reading

1. Khah PT, Shah P, Elkington AR. Injury to the eye. *BMJ* 2004;328(7430):36–8.
2. Kuckelkorn R, Schrage N, Keller G, Redbrake C. Emergency treatment of chemical and thermal eye burns. *Acta Ophthalmol Scand* 2002;80(1):4–10.

on continuous cardiac monitoring with pulse oximetry, and frequent neurologic checks should be made. The initial treatment of hypotension consists of intravenous fluids, followed by vasopressors as needed. The patient's pulmonary status should be monitored closely for clinical signs consistent with pulmonary aspiration. Activated charcoal, syrup of ipecac, and gastric lavage are absolutely contraindicated in patients who have ingested caustic agents. Serum electrolytes should be obtained hourly and include serial calcium, magnesium, and potassium levels. The clinician should obtain serial ECGs looking for signs of hypocalcemia (prolonged QTc interval) and hyperkalemia (peaked T waves). Aggressive replacement of calcium and magnesium will be needed to normalize serum levels. Fluoride-induced hyperkalemia has been reported to be difficult to reverse. Early aggressive therapy with glucose, insulin, and/or sodium bicarbonate may be effective.

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CASE 30 | Acute Abdominal Pain in Pregnancy

Answer: D

Diagnosis: Ruptured ectopic pregnancy

Discussion: In evaluating first-trimester pain and bleeding, no clinical sign or symptom is sufficiently accurate to exclude ectopic pregnancy. All patients need pelvic ultrasonography regardless of the quantitative beta-human chorionic gonadotropin (hCG) level. In fact, a beta-hCG of less than 1,500 mIU/mL has been shown to put a patient with first-trimester pain or bleeding presenting to the emergency department at *increased* risk of ectopic pregnancy compared with patients with higher levels.

The primary focus of the emergency physician performing pelvic ultrasonography for first-trimester pain or bleeding is the identification of an intrauterine pregnancy (IUP). Barring the use of progestational agents and/or in vitro fertilization, which increase the risk of heterotopic pregnancy, identification of an IUP effectively rules out ectopic pregnancy. The first step is the correct identification of the uterus (Figure 30.1, arrows), which in this view might be mistaken to include the large retrouterine mass that is probably clotted blood (arrowheads). Free fluid, which heightens the suspicion for ectopic pregnancy, is also noted posterior to the uterus. The calipers indicate a small intrauterine fluid collection (dark region) surrounded by a single layer of endometrium which is relatively hyperechoic (white). This fluid collection alone is insufficient to make the diagnosis of an IUP, so transvaginal ultrasound will be necessary.

The earliest sign of an IUP is a double decidual sac (also known as the “double decidual sign”), composed of two layers of endometrium surrounding an anechoic sac. This sac usually has smooth walls, is eccentrically located, and is rounded in shape (Figure 30.2), unlike the image of the present case, which shows a single layer of endometrium with a centrally located fluid collection with pointed ends. As can be seen in Figure 2, the two layers of the double decidual sac are relatively hyperechoic (white) compared with the surrounding myometrium. Typically, the outer layer (arrows) does not form a complete ring around the inner layer (arrowheads). The double decidual sign is used by some as evidence of an IUP, but most sonographers consider the presence of a yolk sac within a gestational sac to be the earliest definitive sign, followed by a fetal pole and/or intrauterine fetal heart tones.

If the patient had a low quantitative beta-hCG (<1,500 mIU/mL), had only a small, round, fluid collection in the uterus consistent with a gestational sac (Figure 30.3), and did not have an adnexal mass or fluid collection, the ultrasound image would have been interpreted as “possible early IUP (viable or non-viable), cannot rule out ectopic.” Assuming the patient is clinically stable and reliable, she could be discharged with strict instructions

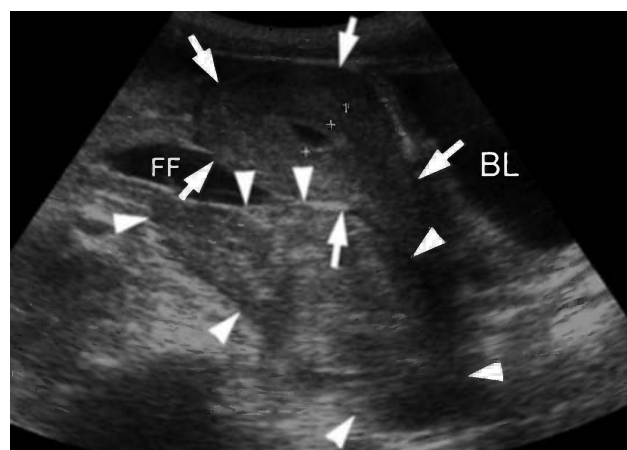


Figure 30.1 Image with markers. See text for details. BL, bladder; FF, free fluid.

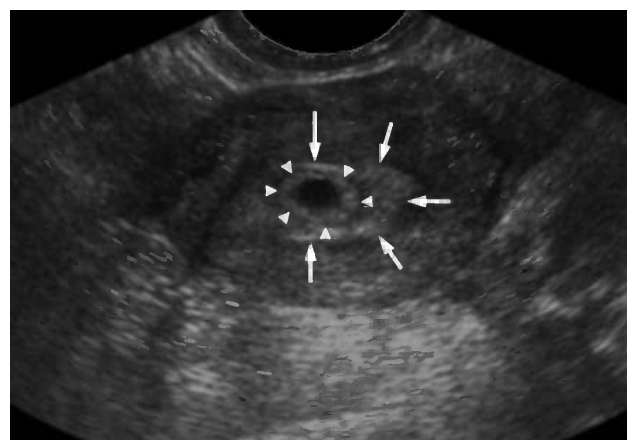


Figure 30.2 Double decidual sac: transverse view of the uterus.

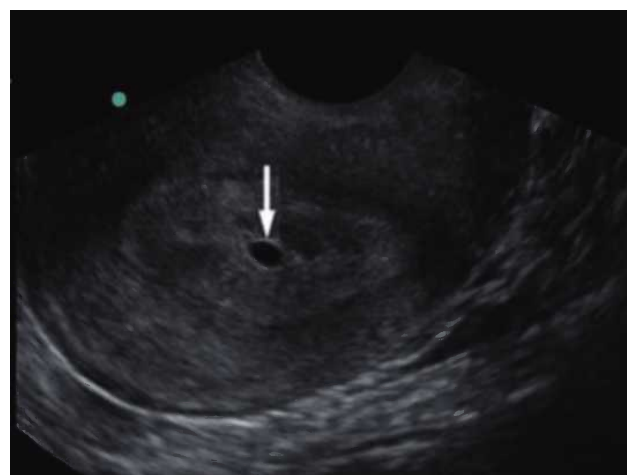


Figure 30.3 Gestational sac (arrow) seen on a sagittal view of the uterus on transvaginal ultrasound.

to return for repeat evaluation with a quantitative beta-hCG assessment in 2–3 days. This strategy allows for serial quantitative beta-hCG evaluations. If the patient does indeed have a viable early IUP, the beta-hCG will double every 2–3 days. If the beta-hCG falls by half every 2–3 days, the patient most likely has an intrauterine fetal demise, with abortion either complete or inevitable. She will be followed as an outpatient until her beta-hCG falls to zero. If the beta-hCG does not follow either of these courses, the presence of an ectopic pregnancy is more likely, although abnormal IUP is still a possibility. Gynecologic management with continued serial observation, laparoscopy, or dilatation and curettage will be determined by clinical factors in combination with patient and physician preference.

With the large adnexal mass seen in the current case, the diagnosis is very suspicious for ruptured ectopic, regardless of the patient's beta-hCG and clinical appearance. Transvaginal ultrasound is warranted to further elucidate whether the patient has other signs of an ectopic pregnancy, such as an adnexal mass or extrauterine ges-

tational sac, or whether an IUP can be confirmed by the presence of a yolk sac within an intrauterine gestational sac. If an IUP cannot be confirmed, urgent obstetrical evaluation in the emergency department is necessary, with preparations for operative management.

Further reading

1. ACEP Clinical Policies Committee and Clinical Policies Subcommittee on Early Pregnancy. American College of Emergency Physicians. Clinical policy: critical issues in the initial evaluation and management of patients presenting to the emergency department in early pregnancy. *Ann Emerg Med* 2003;41(1):123–33.
2. Kaplan BC, Dart RG, Varaklis K. Predictive value of history and physical examination in patients with suspected ectopic pregnancy. *Ann Emerg Med* 1999;33(3):283–90.

Acknowledgement: We thank Anthony J. Dean, MD for his contribution to this case in the previous edition.

CASE 31 | Coma Following Head Trauma

Answer: D

Diagnosis: Epidural hematoma

Discussion: An epidural hematoma (EDH) is the accumulation of blood in the space between the dura and the inner surface of the skull that results from trauma in 85–90% of cases. The temporoparietal region is the area most commonly fractured (66–80% of the time), which results in damage to the underlying middle meningeal artery or one of its dural branches. The extravasation of blood is limited by the suture lines due to the attachment of the dura to the skull at these points. EDHs are most common in people less than 20 years old (60% of cases); they are rare in children less than 2 years of age because the skull is soft and less likely to fracture, and rare in adults older than 50, in whom the dura is more tightly adherent to the skull.

The classic “lucid interval” between the initial loss of consciousness at the time of injury and a delayed decline of level of consciousness is seen in less than a third of cases. Posterior fossa EDHs are associated with a delayed but extremely rapid deterioration of mental status that can quickly progress to coma or death in only a matter of minutes. The most common presenting signs and symptoms are severe headache, nausea, seizure, and occasionally focal neurologic deficits. On examination, the Cushing response from increased intracranial pressure might

result in hypertension and bradycardia. Lacerations, contusions, or bony step-offs indicative of underlying skull fracture are common but not always present. Dilated, sluggish or fixed pupils bilaterally or ipsilaterally to the side of injury are concerning for increased intracranial pressure and impending herniation.

An emergent head computed tomography (CT) scan without contrast is indicated in all patients with suspicion for an EDH. Acute EDHs may appear as a lens-shaped hypodensity between the skull and brain parenchyma – a convex, bulging outward contour. Lumbar puncture is not indicated. Once the diagnosis has been made, immediate neurosurgic consultation is needed. Small EDHs can be treated conservatively, but larger or unstable EDHs require surgical evacuation. Signs of increased intracranial pressure should be managed by elevating the head of the bed to 30 degrees once the cervical spine has been cleared, assuring an adequate blood pressure, and administering mannitol at a dose 0.25–1.0 g/kg intravenously. Intubated patients should be ventilated at 16–20 breaths per minute with a tidal volume of 10–12 mL/kg to maintain a carbon dioxide partial pressure of 28–32 mmHg. Prognosis is usually excellent with early intervention, with mortality rates ranging from 0% in preoperatively noncomatose patients to 20–40% in those in a coma before surgery.

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Further reading

1. Ibanez J, Arikan F, Pedraza S. Reliability of clinical guidelines in the detection of patients at risk following mild head injury: results of a prospective study. *J Neurosurg* 2004;100(5):825–34.
2. Lee EJ, Hung YC, Wang LC. Factors influencing the functional outcome of patients with acute epidural hematomas: analysis of 200 patients undergoing surgery. *J Trauma* 1998;45(5):946–52.

CASE 32 | Tongue Swelling in a Hypertensive Female

Answer: C

Diagnosis: Angioedema secondary to angiotensin-converting enzyme inhibitor

Discussion: Angioedema is a condition marked by non-dependent, asymmetric edema of the deep dermal and subcutaneous tissues, commonly involving the face, lips, tongue, and oropharynx. Edema results from a loss of vascular integrity and bradykinin-mediated extravasation of fluid into the interstitial tissues.

Histamine-mediated angioedema (HMA) is typically associated with urticaria formation (a more superficial process) and, like anaphylaxis, involves both hypersensitivity and IgE-mediated allergic reactions. These reactions result in the release of histamine and other mediators from mast cells typically from exposure to food and drug allergens, as well as *Hymenoptera* envenomations and physical precipitants (e.g., cold and exercise). Both acute cases (lasting <6 weeks) and chronic cases (lasting >6 weeks) have been described. Management of HMA begins with rapid identification and stabilization of airway compromise and hemodynamic instability, coupled with the immediate removal of an offending agent. Additionally, antihistamines and corticosteroids are useful. Epinephrine remains the treatment of choice for any airway compromise or vasomotor instability. The absence of urticaria and/or pruritis should prompt a clinician to consider causes of non-HMA.

Non-HMA, or bradykinin-mediated angioedema (BKMA), is thought to occur independently of mast cell degranulation and thus in the absence of urticaria and pruritis. Excess bradykinin and substance P activity have been implicated in disruption of vascular tone and permeability associated with BKMA. Both drug-induced and hereditary angioedema are known to produce BKMA. The most common cause of BKMA presenting to emergency rooms is exposure to angiotensin-converting enzyme inhibitor (ACEI). The incidence of BKMA with ACEI is highest in the first month of therapy (25%), but it can develop years after uneventful use (overall incidence 0.1–0.7%). ACEI-induced BKMA is more common in older patients, females, those with diabetes, and

African-Americans. ACEI-induced BKMA is not related to the development of ACEI-induced cough.

Hereditary BKMA (HAE) is an autosomal-dominant disorder involving a deficiency in the C1-esterase inhibitor that affects fewer than 200,000 people in the USA. HAE typically presents in childhood and is associated with a family history. Traumatic or stressful situations can lead to a transient elevation in bradykinin levels resulting in edema of the airway, face, genitalia, and extremities. Abdominal pain is a common complaint. Acquired, functional deficiencies in C1-esterase activity also exist and are commonly associated with malignancy and older age.

Similar to the treatment of HMA, BKMA requires particular focus on the patient's airway and vasomotor stability. Epinephrine (adrenaline) and definitive airway management (endotracheal intubation or surgical airway) are required for any airway or circulatory compromise. Aerosolized racemic epinephrine, antihistamines, and corticosteroids may have some benefit, and their administration should be considered in patients with BKMA.



Figure 32.1 A patient with isolated lower lip edema secondary to ACEI-induced BKMA. This swelling resolved after 4 hours of observation in the emergency department. No pharmacologic therapy was necessary.

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Avoidance of ACEIs and close observation for progression is essential. The treatment of choice for acute presentations of HAE is fresh frozen plasma or C1-esterase inhibitor concentrate. In addition, androgens (stanozolol and danazol) have been used to prevent and treat this condition in the acute setting. Investigational agents including C1-inhibitor replacement protein, ecallantide (DX88; a kallikrein inhibitor capable of preventing the formation of bradykinin), and icatibant (a bradykinin receptor-2 antagonist) are exciting future possibilities.

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1. Grigoriadou S, Longhurst HJ. Clinical Immunology Review Series: An approach to the patient with angioedema. *Clin Exp Immunol* 2009;155:367–77.
2. Temino VM, Peebles RS. The spectrum and treatment of angioedema. *Am J Med* 2008;121:282–6.
3. Kulthanan K, Jiamton S, Boochangkool K, Jongjarearnprasert K. Angioedema: clinical and etiological aspects. *Clin Dev Immunol* 2007;26:438.

CASE 33 | Purulent Eye Discharge in an Adult

Answer: C

Diagnosis: Bacterial conjunctivitis due to *Neisseria gonorrhoeae*

Discussion: Bacterial conjunctivitis can affect patients of all ages. The causative organisms are numerous and differ in frequency between adults and children. Symptoms of bacterial conjunctivitis include hyperemia, ocular discharge, the eyelids being matted together in the morning, and a foreign body sensation.

Hyperacute, purulent conjunctivitis is the most severe form of bacterial conjunctivitis and is classically associated with *Neisseria gonorrhoeae*. This infection may progress rapidly to involve the cornea, resulting in scarring or perforation. The abrupt onset of symptoms and hyperpurulent discharge will often bring these patients to the emergency department for evaluation and treatment.

Broad-spectrum, topical antibiotic therapy is sufficient for most acute conjunctival infections. However, any suspicion of gonococcal infection requires laboratory evaluation.

Gram staining, looking for Gram-negative, intracellular diplococci, along with culture and sensitivity of conjunctival scrapings should be done prior to treatment. Cultures should be placed on chocolate agar, blood agar, and Thayer–Martin media.

Treatment for gonococcal conjunctivitis requires topical and systemic therapy. Ceftriaxone, 1 g intravenously or intramuscularly, and topical ciprofloxacin ophthalmic drops every 2 hours is usually effective, along with irrigation with sterile saline four times a day. Treatment for concomitant chlamydial co-infection, and evaluation of the patient's sexual partners, is also recommended.

Further reading

1. Tarabishy, AB, Jeng BH. Bacterial conjunctivitis: a review for internists. *Cleve Clin J Med* 2008;75(7):507–12.
2. Deschenes J, Seamone C, Baines M. The ocular manifestations of sexually transmitted diseases. *Can J Ophthalmol* 1990; 25(4):177–85.

CASE 34 | Shoulder Pain Following Direct Blow

Answer: D

Diagnosis: Type II acromioclavicular separation

Discussion: The acromioclavicular (AC) joint stabilizes the scapula and glenohumeral joint in relation to the thorax. It forms the only direct, bony connection between the arm and the thorax and axial skeleton. The acromioclavicular joint is stabilized by several structures: the AC joint capsule and ligaments, the coracoacromial ligament, and the coracoclavicular (CC) ligament. AC separation is an injury to the AC joint and most commonly results from a direct fall on the shoulder with the ipsilateral arm in

adduction. Less frequently, this injury can result from a fall on outstretched hand (“FOOSH”) or elbow. The severity of injury to the AC joint depends upon the number of these structures damaged.

AC separations are classified by the Rockwood classification into types I–VI. A type I AC separation (a sprain or partial disruption of the AC ligament) reveals tenderness to palpation over the AC joint on physical examination, but there is no palpable deformity and radiographs appear normal. Radiographs of a type II AC separation (complete disruption of the AC ligament, with intact CC

Avoidance of ACEIs and close observation for progression is essential. The treatment of choice for acute presentations of HAE is fresh frozen plasma or C1-esterase inhibitor concentrate. In addition, androgens (stanozolol and danazol) have been used to prevent and treat this condition in the acute setting. Investigational agents including C1-inhibitor replacement protein, ecallantide (DX88; a kallikrein inhibitor capable of preventing the formation of bradykinin), and icatibant (a bradykinin receptor-2 antagonist) are exciting future possibilities.

Further reading

1. Grigoriadou S, Longhurst HJ. Clinical Immunology Review Series: An approach to the patient with angioedema. *Clin Exp Immunol* 2009;155:367–77.
2. Temino VM, Peebles RS. The spectrum and treatment of angioedema. *Am J Med* 2008;121:282–6.
3. Kulthanan K, Jiamton S, Boochangkool K, Jongjarearnprasert K. Angioedema: clinical and etiological aspects. *Clin Dev Immunol* 2007;26:438.

CASE 33 | Purulent Eye Discharge in an Adult

Answer: C

Diagnosis: Bacterial conjunctivitis due to *Neisseria gonorrhoeae*

Discussion: Bacterial conjunctivitis can affect patients of all ages. The causative organisms are numerous and differ in frequency between adults and children. Symptoms of bacterial conjunctivitis include hyperemia, ocular discharge, the eyelids being matted together in the morning, and a foreign body sensation.

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CASE 34 | Shoulder Pain Following Direct Blow

Answer: D

Diagnosis: Type II acromioclavicular separation

Discussion: The acromioclavicular (AC) joint stabilizes the scapula and glenohumeral joint in relation to the thorax. It forms the only direct, bony connection between the arm and the thorax and axial skeleton. The acromioclavicular joint is stabilized by several structures: the AC joint capsule and ligaments, the coracoacromial ligament, and the coracoclavicular (CC) ligament. AC separation is an injury to the AC joint and most commonly results from a direct fall on the shoulder with the ipsilateral arm in

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CASE 33 | Purulent Eye Discharge in an Adult

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CASE 34 | Shoulder Pain Following Direct Blow

Answer: D

Diagnosis: Type II acromioclavicular separation

Discussion: The acromioclavicular (AC) joint stabilizes the scapula and glenohumeral joint in relation to the thorax. It forms the only direct, bony connection between the arm and the thorax and axial skeleton. The acromioclavicular joint is stabilized by several structures: the AC joint capsule and ligaments, the coracoacromial ligament, and the coracoclavicular (CC) ligament. AC separation is an injury to the AC joint and most commonly results from a direct fall on the shoulder with the ipsilateral arm in

adduction. Less frequently, this injury can result from a fall on outstretched hand (“FOOSH”) or elbow. The severity of injury to the AC joint depends upon the number of these structures damaged.

AC separations are classified by the Rockwood classification into types I–VI. A type I AC separation (a sprain or partial disruption of the AC ligament) reveals tenderness to palpation over the AC joint on physical examination, but there is no palpable deformity and radiographs appear normal. Radiographs of a type II AC separation (complete disruption of the AC ligament, with intact CC

ligaments) reveal slight widening of the AC joint and upward or posterior displacement of the distal clavicle in relation to the acromion (Figure 34.1). This separation can range from a few percent to 100%. When the displacement is greater than 100%, the injury is a type III AC separation, with complete disruption of the AC and CC joints. Types IV–VI are uncommon; in these, the lateral clavicle is widely displaced from the acromion due to dislocation of the distal clavicle and/or deltotracheal fascia disruption.

Management of AC separations is usually symptomatic and nonoperative. All orthopedic injuries require careful evaluation to rule out accompanying injuries. Type I separations are treated with analgesia, ice, a sling for comfort, and a brief period of immobilization, followed by progressive strengthening and range-of-motion exercises. The general consensus is that type II injuries should be managed in the same way as type I. For both types, patients most often return to their preinjury level of activity.

Indications for orthopedic consultation and/or operative repair include types III–VI AC separations, significant tenting of the skin, and open AC separations. Type III–VI injuries are rare. There is controversy about the management of type III AC separations, with some shoulder specialists favoring conservative management and others favoring operative repair. Types IV–VI all require operative intervention.

Neither “weighted X-rays” nor figure-of-eight bandages have a role in the management of AC separations. In the past, patients with type II AC separations were evaluated with “weighted X-rays,” where the patient held a 10-pound weight in the hand on the injured side to maximize the degree of displacement between the clavicle and the acromion and rule out occult type III separations. This process increases cost, radiation, and pain, and has not been found to significantly change management.



Figure 34.1 The same radiograph as in the case with an arrow pointing to the type II AC separation (approximately 50% separation).

Figure-of-eight bandages were previously used in the management of clavicle fractures, but their use has been abandoned because they are difficult for the patient to wear and the fractures frequently become displaced again as soon as the figure-of-eight immobilizer is discontinued.

Further reading

1. Rios CG, Mazzocca AD. Acromioclavicular joint problems in athletes and new methods of management. *Clin Sports Med* 2008;27(4):763–88.
2. Montellese P, Dancy T. The acromioclavicular joint. *Prim Care* 2004;31(4):857–66.

Acknowledgement: We thank David F. Gaieski, MD for his contribution to this case in the previous edition.

CASE 35 | A Gagging Child

Answer: D

Diagnosis: Esophageal foreign body

Discussion: Evaluation of patients who have ingested foreign bodies is not an uncommon occurrence in the emergency department. Children aged 18–48 months are most likely to swallow solid objects such as toys, coins, pins, and button batteries. Many of these objects are radio-opaque and can be seen on a plain radiograph. If an ingested foreign body is suspected, plain radiographs of the entire gastrointestinal tract, from neck to rectum, are the most appropriate initial imaging study. Portable radiographs should be obtained if transport outside the emergency department will put the patient at risk.

Esophageal foreign bodies can be distinguished from those that become trapped in the trachea based on their position on plain radiograph. Due to the ring structure of the trachea, coin-shaped or other flat-sided objects tend to lie in the sagittal plane, pushing against the muscular posterior wall of the trachea, and are thus seen lying flat on anteroposterior (AP) films. Conversely, objects lodged in the esophagus tend to become lodged in the coronal plane and are therefore seen lying vertically on an AP film and posterior to the tracheal air column on a lateral chest radiograph.

When plain films fail to identify an ingested foreign body and a high index of suspicion remains, a number of

ligaments) reveal slight widening of the AC joint and upward or posterior displacement of the distal clavicle in relation to the acromion (Figure 34.1). This separation can range from a few percent to 100%. When the displacement is greater than 100%, the injury is a type III AC separation, with complete disruption of the AC and CC joints. Types IV–VI are uncommon; in these, the lateral clavicle is widely displaced from the acromion due to dislocation of the distal clavicle and/or deltotracheal fascia disruption.

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Further reading

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When plain films fail to identify an ingested foreign body and a high index of suspicion remains, a number of

diagnostic options are available. A swallowing study with contrast material may reveal filling defects in the esophagus, suggesting the location of a foreign body. Use of this option is limited if there is a high risk for aspiration or if perforation is suspected. Furthermore, any ingested contrast material may complicate future endoscopic evaluation. For these reasons, a noncontrast computed tomography (CT) scan is preferred as it is excellent both for visualizing radiolucent foreign bodies and for characterizing other pathology related to longstanding impaction (perforation or abscess formation).

In adults, ingested foreign bodies tend to lodge in the lower esophageal sphincter, whereas in children blunt objects can lodge in several anatomic narrowings in the esophagus. The most common site, accounting for approximately 70% of impactions, is the thoracic inlet, located between the clavicles on a chest radiographs, where the cricopharyngeus muscle acts as a sling where objects can catch. The remaining 30% occur at the level of the aortic arch or the lower esophageal sphincter. If a foreign body is lodged at any other point in the esophagus, underlying esophageal pathology must be suspected. Sharp objects can become lodged at any point along the gastrointestinal tract.

The longer a foreign body remains impacted, the greater the risk for complications such as pressure necrosis, infection, stricture, fistula formation and perforation. Once an object has passed into the stomach, it is likely to pass through the rest of the gastrointestinal tract unless it is too long (>6cm) or too wide (>2cm) to pass through the pyloric sphincter. Another distal site of potential impaction is the ileocecal valve.

Asymptomatic children with ingested blunt foreign bodies may undergo a brief (8–16 hours) observation period for spontaneous passage, particularly if the object is already in the distal third of the esophagus at time of presentation. Conversely, children who present with drooling, dysphagia, vomiting, and anorexia require emergent intervention. Direct visualization of the foreign body by endoscopy is both the diagnostic and therapeutic

modality of choice for symptomatic patients. Endoscopy should also be employed emergently for sharp foreign bodies in the esophagus and stomach, as well as for ingested button batteries in the esophagus, which can cause mucosal necrosis and perforation within hours of impaction. Sharp objects that have passed distal to the pyloric sphincter require emergent surgical consultation.

In addition to endoscopy, several other methods for foreign body dislodgement have been described, with similar success and complication rates. Perhaps the most commonly employed is esophageal bougienage in which a bougie is used to push an impacted object distally into the stomach, where it will ideally transit the rest of the gastrointestinal tract uneventfully. Another involves the use of a balloon catheter passed distal to the level of the foreign body. The balloon is filled with contrast material, placed distal to the foreign body, and the foreign body can be removed using fluoroscopy up the esophagus and out via the oropharynx. These techniques have an advantage over endoscopic removal in that they are inexpensive and do not require significant anesthesia. However, like endoscopy, they can be complicated by vomiting, aspiration, and esophageal perforation or scarring. Medical options employ agents such as glucagon, sublingual nitroglycerin, and nifedipine to relax the lower esophageal sphincter, with expectant passage of the foreign body beyond that point. Emetics (ipecac) are not recommended because of the potential for both aspiration and esophageal injury in the setting of vomiting against a fixed obstruction.

Further reading

1. Arms JL, Mackenberg-Mohn MD, Bowen MV, et al. Safety and efficacy of a protocol using bougienage or endoscopy for the management of coins acutely lodged in the esophagus: a large case series. *Ann Emerg Med* 2008;51(4):367–72.
2. Waltzman ML, Baskin M, Wypij D, et al. A randomized clinical trial of the management of esophageal coins in children. *Pediatrics* 2005;116(3):614–19.

CASE 36 | Adult Male with a Sudden, Severe Headache

Answer: E

Diagnosis: Subarachnoid hemorrhage

Discussion: A non-traumatic subarachnoid hemorrhage (SAH) most commonly results from a ruptured aneurysm (80% of the time) within the subarachnoid space and leads to the death or disability of 18,000 people in North America annually. Aneurysms are acquired lesions from vascular stresses at bifurcations or bends of arteries;

rupture is more likely in people with hypertension, those who smoke or drink alcohol, and those with multiple or enlarging aneurysms. The median age for a SAH is 50 years, and there is a 2.1-fold increased incidence in African-Americans compared with white individuals, as well as a slightly higher incidence in women than in men.

The typical presentation of a SAH is the acute onset of a severe “thunderclap” headache that is classically

diagnostic options are available. A swallowing study with contrast material may reveal filling defects in the esophagus, suggesting the location of a foreign body. Use of this option is limited if there is a high risk for aspiration or if perforation is suspected. Furthermore, any ingested contrast material may complicate future endoscopic evaluation. For these reasons, a noncontrast computed tomography (CT) scan is preferred as it is excellent both for visualizing radiolucent foreign bodies and for characterizing other pathology related to longstanding impaction (perforation or abscess formation).

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rupture is more likely in people with hypertension, those who smoke or drink alcohol, and those with multiple or enlarging aneurysms. The median age for a SAH is 50 years, and there is a 2.1-fold increased incidence in African-Americans compared with white individuals, as well as a slightly higher incidence in women than in men.

The typical presentation of a SAH is the acute onset of a severe “thunderclap” headache that is classically

described as “the worst headache of my life.” As many as 30–50% of patients will report sentinel headaches over the proceeding weeks to months that result from the slow leakage of blood. Signs of meningeal irritation are seen in over 75% of patients, although it may take several hours for these symptoms to manifest. One-half of patients will experience loss of consciousness at the onset of the bleed, and between one-tenth and one-quarter will experience a seizure within an hour of onset. Nausea, vomiting, and photophobia are also common presenting symptoms. About 50% of patients will have increased blood pressure at the time of presentation from the Cushing response. The physical examination may be normal, but approximately one-quarter will have non-focal neurologic abnormalities. Papilledema or subhyloid retinal hemorrhages may be present on fundoscopic examination.

A noncontrast computed tomography (CT) of the head is indicated as the diagnostic test of choice in all patients with suspected SAH and is most sensitive at 24 hours after the onset, although it will be falsely negative in as many as 10–15% of patients. A lumbar puncture should be considered when there is a high clinical suspicion but a negative head CT; lumbar puncture is positive when there is a consistently elevated number of red blood cells in two consecutive tubes of cerebrospinal fluid (CSF) or if xanthochromia, the resulting CSF color change from red

blood cell degradation, is present. A lumbar puncture may be falsely negative less than 2 hours after the onset of bleeding and is most sensitive 12 hours after the bleed.

Once the diagnosis has been made, neurosurgical consultation with cerebral angiography should be obtained to assess the status of the bleeding. Patients should be considered for nonsedating seizure prophylaxis and calcium channel blockers that reduce the incidence of cerebral vasospasm. A goal mean blood pressure of less than 130mmHg should be obtained with antihypertensive agents. If herniation is suspected, mannitol or furosemide can be used to reduce intracranial pressure. The prognosis of patients with SAH is poor: between 10% and 15% will die before reaching the hospital, 40% will die within a week, and over half will die within 6 months.

Further reading

1. Edlow JA. Diagnosis of subarachnoid hemorrhage. *Neurocrit Care* 2005;2(2):99–109.
2. Le Roux PD, Winn HR. Management of the ruptured aneurysm. *Neurosurg Clin North Am* 1998;9(3):525–40.
3. Liebenberg WA, Worth R, Firth GB. Aneurysmal subarachnoid haemorrhage: guidance in making the correct diagnosis. *Postgrad Med J* 2005;81(957):470–3.

CASE 37 | New Facial Droop

Answer: A

Diagnosis: Bell’s palsy

Discussion: The patient pictured has Bell’s palsy. Note the ptosis of the left eye and the weakness of the orbicularis muscles on the left side of the face. Also note the absence of wrinkling to the forehead on the affected left side. Bell’s palsy is the most common disorders affecting the facial nerve. It is an abrupt, isolated, unilateral, peripheral facial paralysis without detectable causes. While the actual pathophysiology is unknown, the most widely accepted theory postulates inflammation of the facial nerve causing it to be compressed as it courses through the temporal bone.

The incidence in the United States is approximately 23 cases per 100,000 persons. It occurs equally in men and women, most commonly between ages 10 and 40 years. Clinical conditions associated with Bell’s palsy include pregnancy (especially the third trimester), immunocompromised states, and diabetes. Patients may present with a concern that they have suffered a stroke. Other common symptoms include pain in or behind the ear, numbness

on the affected side of the face, a recent upper respiratory infection, drooling, alteration in taste, and hyperacusis.

The classic definition describes a lower motor neuron deficit of the facial nerve, manifesting as weakness of the entire face (upper and lower) on the affected side. This is in contradistinction to upper motor neuron lesions such as a cortical stroke, where the upper third of the face is spared while the lower two-thirds are paralyzed. While considered to be an idiopathic facial paralysis, there is significant evidence to support an infectious cause. Herpes simplex virus (HSV-1) has been isolated in many patients and is the most likely infectious agent, although there are likely other etiologic agents with a shared common pathway leading to facial nerve dysfunction.

No specific laboratory tests exist to diagnose Bell’s palsy. Clinical suspicion helps to direct what tests may be of value, and may include thyroid function studies and Lyme titer. One can also consider obtaining (if clinically suspected) a Rapid Plasma Reagin or a Venereal Disease Research Laboratory test for syphilis, as well as a human

described as “the worst headache of my life.” As many as 30–50% of patients will report sentinel headaches over the proceeding weeks to months that result from the slow leakage of blood. Signs of meningeal irritation are seen in over 75% of patients, although it may take several hours for these symptoms to manifest. One-half of patients will experience loss of consciousness at the onset of the bleed, and between one-tenth and one-quarter will experience a seizure within an hour of onset. Nausea, vomiting, and photophobia are also common presenting symptoms. About 50% of patients will have increased blood pressure at the time of presentation from the Cushing response. The physical examination may be normal, but approximately one-quarter will have non-focal neurologic abnormalities. Papilledema or subhyloid retinal hemorrhages may be present on fundoscopic examination.

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Further reading

1. Edlow JA. Diagnosis of subarachnoid hemorrhage. *Neurocrit Care* 2005;2(2):99–109.
2. Le Roux PD, Winn HR. Management of the ruptured aneurysm. *Neurosurg Clin North Am* 1998;9(3):525–40.
3. Liebenberg WA, Worth R, Firth GB. Aneurysmal subarachnoid haemorrhage: guidance in making the correct diagnosis. *Postgrad Med J* 2005;81(957):470–3.

CASE 37 | New Facial Droop

Answer: A

Diagnosis: Bell’s palsy

Discussion: The patient pictured has Bell’s palsy. Note the ptosis of the left eye and the weakness of the orbicularis muscles on the left side of the face. Also note the absence of wrinkling to the forehead on the affected left side. Bell’s palsy is the most common disorders affecting the facial nerve. It is an abrupt, isolated, unilateral, peripheral facial paralysis without detectable causes. While the actual pathophysiology is unknown, the most widely accepted theory postulates inflammation of the facial nerve causing it to be compressed as it courses through the temporal bone.

The incidence in the United States is approximately 23 cases per 100,000 persons. It occurs equally in men and women, most commonly between ages 10 and 40 years. Clinical conditions associated with Bell’s palsy include pregnancy (especially the third trimester), immunocompromised states, and diabetes. Patients may present with a concern that they have suffered a stroke. Other common symptoms include pain in or behind the ear, numbness

on the affected side of the face, a recent upper respiratory infection, drooling, alteration in taste, and hyperacusis.

The classic definition describes a lower motor neuron deficit of the facial nerve, manifesting as weakness of the entire face (upper and lower) on the affected side. This is in contradistinction to upper motor neuron lesions such as a cortical stroke, where the upper third of the face is spared while the lower two-thirds are paralyzed. While considered to be an idiopathic facial paralysis, there is significant evidence to support an infectious cause. Herpes simplex virus (HSV-1) has been isolated in many patients and is the most likely infectious agent, although there are likely other etiologic agents with a shared common pathway leading to facial nerve dysfunction.

No specific laboratory tests exist to diagnose Bell’s palsy. Clinical suspicion helps to direct what tests may be of value, and may include thyroid function studies and Lyme titer. One can also consider obtaining (if clinically suspected) a Rapid Plasma Reagin or a Venereal Disease Research Laboratory test for syphilis, as well as a human

immunodeficiency virus test. There is no evidence to support emergent imaging studies with Bell's palsy.

The primary treatment in the emergency department is with pharmacologic management. The remainder of care focuses on patient education as to the course of the disease and eye care instructions. While considered by some to be controversial, treatment with steroids remains common if the patient presents within 7 days of symptom onset. The postulated mechanism of action is in reducing facial nerve swelling. Current data supports using steroids as a means to improve outcomes, and earlier treatment is preferred (i.e., prednisone at 40–60 mg per day for 7–14 days). Some recent evidence supports HSV as the presumed cause in more than 70% of cases; therefore, antiviral agents have been a logical choice for pharmacologic management. Recommendations include acyclovir 400–800 mg five times a day for 10 days, or valacyclovir 1 g three times a day for 10 days. It should be noted, however, that recent literature has challenged this traditional treatment, and many practitioners are no longer using it.

The eye on the affected side is potentially at risk for corneal drying and foreign body exposure, as the lid may not close completely, especially when the patient is asleep.

This is generally managed with artificial tears and some form of eye protection (patch or glasses during the day, taping the eye shut at night).

The vast majority (85% or more) of patients recover without any cosmetically obvious deformities. Ultimately, 10% will have some residual asymmetry of the facial muscles, and 5% will suffer from significant facial nerve deficits. In most cases, recovery begins 3 weeks after symptom onset, but it may take up to a year for complete resolution. Patients with incomplete facial nerve involvement have a more favorable prognosis than those with a complete deficit.

Further reading

1. Gilchrist JM. Seventh cranial neuropathy. *Semin Neurol* 2009;29(1):5–13.
2. Hazin R, Azizzadeh B, Bhatti MT. Medical and surgical management of facial nerve palsy. *Curr Opin Ophthalmol* 2009;20(6):440–50.
3. Quant EC, Jeste SS, Muni RH, et al. The benefits of steroids versus steroids plus antivirals for treatment of Bell's palsy: a meta-analysis. *BMJ* 2009;339:b3354.

CASE 38 | Eye Pain After Tree Branch Strike

Answer: B

Diagnosis: Corneal abrasion

Discussion: The photographs with the question demonstrate a defect in the corneal epithelium before and after staining with fluorescein. Patients with corneal abrasions usually complain of sharp pain, foreign body sensation, and tearing. A history of antecedent trauma can usually be elicited. Patients without a history of trauma may be suffering from recurrent corneal erosion syndrome; however, herpes simplex keratitis must also be ruled out in these cases.

Slit-lamp examination is critical in the work-up of corneal abrasions to determine the size, depth, and location of the abrasion. This also allows the clinician to rule out an anterior chamber reaction and infiltrate indicating a true corneal ulcer. Finally, a careful slit-lamp exam with eyelid eversion is necessary to determine the presence of a laceration, penetrating trauma, or foreign body.

Treatment for corneal abrasions should include a topical antibiotic. Erythromycin ointment or trimethoprim/polymyxin B drops given four times a day is usually sufficient. Contact lens wearers should be given an antibiotic with pseudomonal coverage such as tobramycin or cipro-

floxacin. Steroid use should be avoided. Cycloplegic agents such as cyclopentolate or homatropine may be given twice a day for comfort from traumatic iritis. Tetanus immunization status should be assessed and a booster immunization given if necessary. Contact lens wearers must discontinue lens wear until the abrasion has been completely healed for a week.

The primary indication for patching is patient comfort by immobilizing the eyelid from rubbing up and down over the denuded surface. Small or superficial abrasions do not require patching. Larger abrasions may be patched if it makes the patient more comfortable. Abrasions involving vegetative matter or if the patient wears contact lenses should not be patched. Patients should be re-evaluated in 24 hours.

Further reading

1. Wilson SA, Last A. Management of corneal abrasions. *Am Fam Physician* 2004;70(1):123–8.
2. Mukherjee P, Sivakumar A. Tetanus prophylaxis in superficial corneal abrasions. *Emerg Med J* 2003;20(1):62–4.

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CASE 39 | An Elderly Woman with Groin Pain

Answer: B

Diagnosis: Avascular necrosis of the left femoral head

Discussion: Patients presenting with progressive groin and/or thigh pain radiating to the buttock should be evaluated for avascular necrosis of the femoral head. Avascular necrosis (AVN) is a progressive disease of joint destruction that has many causes. Steroid exposure (as seen in our patient), alcoholism, hemoglobinopathies, renal disease, and a history of hip fracture or hip dislocation all put patients at risk for ischemia of the femoral head. Independent of the precipitating event, all patients with ischemic bone will develop abnormal bone growth, edema, and ultimately fibrosis. Males are at higher risk for AVN, and it typically develops in patients after age 40. Groin pain that is worse with weight-bearing and a limited range of motion of the affected joint are common initial complaints. Plain radiographic findings can lag behind clinical symptoms of hip pain and difficulty walking.

The diagnosis is made in the appropriate clinical setting and is confirmed by radiographic studies. Plain radiographic studies including anteroposterior and frog leg lateral views have poor sensitivity early in the course due to the slow process of bone remodeling. The gold standard for diagnosis, magnetic resonance imaging, can detect changes as early as 5 days after an acute vascular insult and has a sensitivity and specificity of 99%. A number of staging systems exists for AVN that characterize the progression of disease from stage 0 (in all systems), in which no changes are visible on imaging studies, through a series of stages describing early radiographic findings, diffuse changes, subchondral fractures, and finally collapse of the femoral head. In comparison to osteoarthritis, the joint space is preserved until late in the disease process when the entire joint has collapsed. A clinical syndrome of AVN also has a staging system, but it has not been

demonstrated to correlate well with X-ray findings or disease progression.

Treatment options for AVN may initially include avoidance of weight-bearing and medication therapies including bisphosphonates, vasodilators, and antihypertensives. Other nonoperative therapies including hyperbaric oxygen, electrical stimulation, pulsed electromagnetic field therapy, and extracorporeal shock wave therapy have been proposed. In general, however, no “no-operative” therapies have yet been demonstrated to be effective. A number of surgical interventions – generally separated into head-preserving procedures and arthroplasty – have been described. Head-preserving procedures include both percutaneous and open core decompression with or without bone grafting, osteotomy, nonvascularized bone grafting, fibular grafts, and hip and femoral resurfacing. Short-term and long-term success rates vary, and operative decision-making is dependent on a number of factors including age, severity of disease, and functional status. Total hip replacement is the definitive therapy and has excellent success rates and good functional outcomes, but it is often reserved for severe disease and may be delayed or avoided in younger patients.

Further reading

1. Hamilton TW, Goodman SM, Figgie M. SAS Weekly Rounds: Avascular necrosis. *HSS J* 2009;5:99–113.
2. Mont MA, Payman RK, Laporte DM, et al. Atraumatic osteonecrosis of the humeral head. *J Rheumatol* 2000;27(7):1766–73.
3. Musso ES, Mitchell SN, Schink-Ascani M, Bassett CA. Results of conservative management of osteonecrosis of the femoral head. A retrospective review. *Clin Orthop Relat Res* 1986;(207):209–15.

CASE 40 | Rash and Joint Pain in a Child

Answer: A

Diagnosis: Henoch–Schönlein Purpura

Discussion: Henoch–Schönlein purpura (HSP) is the most common systemic vasculitis in children, with a rapid onset over the course of days to weeks. The disease is an example of a leukocytoclastic vasculitis, characterized by immune complex deposition leading to necrosis and inflammation of the small blood vessels, most commonly the postcapillary venules. The disease course is

usually over 6 weeks, with the majority of patients resolving their disease in 1 month. Relapses can occur in 16–40% of patients, up to 2 years after the initial symptoms. Clinical manifestations of HSP are seen in several organ systems including the skin, joints, gastrointestinal tract, and kidney.

Cutaneous involvement is seen in 100% of patients and is characterized by palpable purpura, most commonly on the lower extremities and in dependent areas, such as the

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Cutaneous involvement is seen in 100% of patients and is characterized by palpable purpura, most commonly on the lower extremities and in dependent areas, such as the

posterior thighs and buttocks. However, the rash can involve the upper extremities as well. When the rash is more widespread, it is imperative to differentiate HSP from more serious conditions such as meningococcemia, idiopathic thrombocytopenic purpura, subacute bacterial endocarditis, and hemolytic uremic syndrome.

Joint involvement occurs in 50–80% of patients with HSP, and commonly involves the large lower extremity joints, such as the knees and ankles. True arthritis is rare, but pain, periarticular swelling, and limitation of range of motion can be significant. Usually, anti-inflammatory medications such as naproxen or ibuprofen are helpful for these symptoms. Arthrocentesis is not indicated.

Gastrointestinal involvement is seen in 65–70% of patients with HSP, usually within 1–4 weeks of the onset of rash. Rarely (14–36%), patients may have abdominal pain before the rash is evident. The symptoms usually involve colicky periumbilical pain and vomiting, with or without abdominal distention. This pain is a result of submucosal and subserosal edema and hemorrhage. Rarely, emergent gastrointestinal complications such as small bowel intussusception, bowel ischemia and infarction, and bowel perforation may occur. The use of corticosteroids has been an area of debate for some time in HSP. A recent meta-analysis of the literature on HSP revealed that the use of corticosteroids reduced the mean resolution time of abdominal pain symptoms and increased the odds for abdominal pain resolution. Additionally, early corticosteroid use significantly reduced the odds of developing persistent renal disease. However, the studies included in this meta-analysis were few in number (15), included low numbers of patients,

were retrospective, and had differing definitions of renal involvement. While this represents the best evidence we have supporting the use of corticosteroids in this condition, this is certainly no consensus yet among physicians.

The most significant morbidity associated with HSP is secondary to renal involvement. It is the risk of renal involvement that will dictate the close follow-up these patients require. Renal disease can occur in 20–34% of patients with HSP, and the spectrum ranges from microscopic hematuria, with or without proteinuria, to fulminant renal failure, which can occur in 1–5% of patients. Due to this small yet significant risk, patients with HSP need weekly blood pressure checks and weekly urinalyses throughout the course of disease.

Overall, HSP is a benign vasculitic disease of childhood, requiring mostly supportive care. Two-thirds of patients will resolve their symptoms within 1 month of onset. Close follow-up by a primary care physician is appropriate for the majority of cases.

Further reading

1. Weiss PF, Feinstein JA, Luan X, et al. Effects of corticosteroid on Henoch–Schönlein purpura: a systematic review. *Pediatrics* 2007;120(5):1079–87.
2. Saulsbury FT. Henoch–Schönlein purpura in children. Report of 100 patients and review of the literature. *Medicine* 1999;78(6):395–409.
3. Lanzkowsky S, Lanzkowsky L, Lanzkowsky P. Henoch–Schönlein purpura. *Pediatr Rev* 1992;13(4):130–7.

CASE 41 | Radiology Findings after Laparoscopy

Answer: B

Diagnosis: Postoperative pneumoperitoneum

Discussion: Pneumoperitoneum refers to air within the peritoneal cavity. It characteristically appears as radiolucency between the right hemidiaphragm and the liver, or in a superiorly dependent location on an abdominal X-ray. It usually indicates a perforated abdominal viscus. Tumor, ulcers, or trauma may cause any portion of the bowel to perforate, leading to an associated peritonitis that typically requires urgent abdominal surgery. Pneumoperitoneum does not require surgery in 5–15% cases.

Nonsurgical pneumoperitoneum (NSP) is defined by the presence of air in the peritoneal space that is detectable by plain film X-rays and either is managed successfully by observation and supportive care alone or results

in a non-diagnostic laparotomy. NSP is commonly caused by retained postoperative air after a laparoscopic procedure, where air is insufflated into the peritoneum to aid the surgeon with visualization and manipulation of intra-peritoneal organs. It may also occur after catheter placement in peritoneal dialysis, gastrointestinal endoscopic procedures, mechanical ventilation, cardiopulmonary resuscitation, pneumothorax, pneumomediastinum, sexual intercourse, or vaginal douching.

Postoperative pneumoperitoneum usually resolves 3–6 days after surgery, although it may persist for as long as 24 days. When abdominal pain and distention are minimal, and peritoneal signs and evidence of a systemic inflammatory response (fever, tachycardia, leukocytosis, and tachypnea) are absent, conservative management is appropriate.

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Further reading

1. Roberts PA, Wrenn K, Lundquist S. Pneumoperitoneum after percutaneous endoscopic gastrostomy: a case report and review. *J Emerg Med* 2005;28(1):45–8.
2. Karaman A, Demirbilek S, Akin M, et al. Does pneumoperitoneum always require laparotomy? Report of six cases and review of the literature. *Ped Surg Int* 2005;21(10): 819–24.
3. Mularski RA, Sippel JM, Osborne ML. Pneumoperitoneum: a review of nonsurgical causes. *Crit Care Med* 2000;28(7): 2638–44.

CASE 42 | Postprandial Abdominal Pain in an Elderly Woman

Answer: B

Diagnosis: Gallstone ileus with pneumobilia

Discussion: Gallstone ileus is a condition that occurs when a gallstone erodes through the gallbladder wall into adjacent bowel, creating a cholecystoenteric fistula that provides a pathway for gallstones to travel into the duodenum or transverse colon. It typically presents as a small bowel obstruction, when large gallstones (>2cm) travel to a narrow part of the small bowel (distal ileum or jejunum) and create a mechanical partial obstruction. Gallstone ileus is more prevalent in females and the elderly and causes almost 25% of all partial small bowel obstructions in patients over 65; however, up to one-third of patients do not have a history of biliary colic.

Initial plain X-rays will show partial small bowel obstruction in 70% of cases, but pneumobilia or a calcified mass in distal small bowel can be seen in only a third of plain radiographs. Ultrasound can make a definitive diagnosis with the presence of pneumobilia and the detection of the calculus by tracing the dilated small bowel to the site of the obstruction; however, overlying small loops of bowel can obscure deep calculi, and gas within the gallbladder fossa is frequently not recognized. Due to the multitude of causes for small bowel obstruction and the importance of assessing the level and severity of the obstruction, abdominal computed tomography (CT) scanning with intravenous and oral contrast has been utilized recently to investigate causes for small bowel obstruction.

The presence of gas within the liver must be differentiated by location, either biliary or portal venous system. Portal venous gas tends to be more peripheral and fragmented. The differential diagnosis for portal venous gas includes necrotizing enterocolitis and bowel ischemia. Biliary gas typically outlines the common bile duct and its major branches, and it should prompt one to look for the few causes of pneumobilia: (1) recent surgery (i.e., endoscopic retrograde cholangiopancreatography with sphincterotomy); (2) infection (emphysematous cholecystitis); (3) passage of a gallstone; (4) or the presence of a fistula (cholecystoduodenal or cholecystocolic). When an abdominal CT study reveals the criteria for Rigler's triad of gallstone ileus (small bowel obstruction, pneumobilia, and calcified gallstone in distal small bowel), surgery should be contacted immediately for emergent surgical intervention due to the high mortality rate of greater than 10% with this condition.

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2. Swift SE, Spencer JA. Gallstone ileus: CT findings. *Clin Radiol* 1998;53(6):451–4.

CASE 43 | "Pink Eye" in a Contact Lens Wearer

Answer: C

Diagnosis: Corneal ulcer secondary to *Pseudomonas*

Discussion: The photograph in the question shows a large corneal ulcer depicted by a fluffy stromal infiltrate and an overlying epithelial defect. There are several eti-

ologies of ulcerative keratitis, but infectious causes should be presumed until proven otherwise. Bacterial corneal ulceration is the most common infectious etiology and is often sight-threatening. Virulent pathogens can have a rapid onset and progression that, left untreated, may

Further reading

1. Roberts PA, Wrenn K, Lundquist S. Pneumoperitoneum after percutaneous endoscopic gastrostomy: a case report and review. *J Emerg Med* 2005;28(1):45–8.
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Initial plain X-rays will show partial small bowel obstruction in 70% of cases, but pneumobilia or a calcified mass in distal small bowel can be seen in only a third of plain radiographs. Ultrasound can make a definitive diagnosis with the presence of pneumobilia and the detection of the calculus by tracing the dilated small bowel to the site of the obstruction; however, overlying small loops of bowel can obscure deep calculi, and gas within the gallbladder fossa is frequently not recognized. Due to the multitude of causes for small bowel obstruction and the importance of assessing the level and severity of the obstruction, abdominal computed tomography (CT) scanning with intravenous and oral contrast has been utilized recently to investigate causes for small bowel obstruction.

The presence of gas within the liver must be differentiated by location, either biliary or portal venous system. Portal venous gas tends to be more peripheral and fragmented. The differential diagnosis for portal venous gas includes necrotizing enterocolitis and bowel ischemia. Biliary gas typically outlines the common bile duct and its major branches, and it should prompt one to look for the few causes of pneumobilia: (1) recent surgery (i.e., endoscopic retrograde cholangiopancreatography with sphincterotomy); (2) infection (emphysematous cholecystitis); (3) passage of a gallstone; (4) or the presence of a fistula (cholecystoduodenal or cholecystocolic). When an abdominal CT study reveals the criteria for Rigler's triad of gallstone ileus (small bowel obstruction, pneumobilia, and calcified gallstone in distal small bowel), surgery should be contacted immediately for emergent surgical intervention due to the high mortality rate of greater than 10% with this condition.

Further reading

1. Zaliekas J, Munson JL. Complications of gallstones: the Mirizzi syndrome, gallstone ileus, gallstone pancreatitis, complications of "lost" gallstones. *Surg Clin North Am* 2008;88(6):1345–68.
2. Swift SE, Spencer JA. Gallstone ileus: CT findings. *Clin Radiol* 1998;53(6):451–4.

CASE 43 | "Pink Eye" in a Contact Lens Wearer

Answer: C

Diagnosis: Corneal ulcer secondary to *Pseudomonas*

Discussion: The photograph in the question shows a large corneal ulcer depicted by a fluffy stromal infiltrate and an overlying epithelial defect. There are several eti-

ologies of ulcerative keratitis, but infectious causes should be presumed until proven otherwise. Bacterial corneal ulceration is the most common infectious etiology and is often sight-threatening. Virulent pathogens can have a rapid onset and progression that, left untreated, may

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1. Roberts PA, Wrenn K, Lundquist S. Pneumoperitoneum after percutaneous endoscopic gastrostomy: a case report and review. *J Emerg Med* 2005;28(1):45–8.
2. Karaman A, Demirbilek S, Akin M, et al. Does pneumoperitoneum always require laparotomy? Report of six cases and review of the literature. *Ped Surg Int* 2005;21(10): 819–24.
3. Mularski RA, Sippel JM, Osborne ML. Pneumoperitoneum: a review of nonsurgical causes. *Crit Care Med* 2000;28(7): 2638–44.

CASE 42 | Postprandial Abdominal Pain in an Elderly Woman

Answer: B

Diagnosis: Gallstone ileus with pneumobilia

Discussion: Gallstone ileus is a condition that occurs when a gallstone erodes through the gallbladder wall into adjacent bowel, creating a cholecystoenteric fistula that provides a pathway for gallstones to travel into the duodenum or transverse colon. It typically presents as a small bowel obstruction, when large gallstones (>2cm) travel to a narrow part of the small bowel (distal ileum or jejunum) and create a mechanical partial obstruction. Gallstone ileus is more prevalent in females and the elderly and causes almost 25% of all partial small bowel obstructions in patients over 65; however, up to one-third of patients do not have a history of biliary colic.

Initial plain X-rays will show partial small bowel obstruction in 70% of cases, but pneumobilia or a calcified mass in distal small bowel can be seen in only a third of plain radiographs. Ultrasound can make a definitive diagnosis with the presence of pneumobilia and the detection of the calculus by tracing the dilated small bowel to the site of the obstruction; however, overlying small loops of bowel can obscure deep calculi, and gas within the gallbladder fossa is frequently not recognized. Due to the multitude of causes for small bowel obstruction and the importance of assessing the level and severity of the obstruction, abdominal computed tomography (CT) scanning with intravenous and oral contrast has been utilized recently to investigate causes for small bowel obstruction.

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CASE 43 | "Pink Eye" in a Contact Lens Wearer

Answer: C

Diagnosis: Corneal ulcer secondary to *Pseudomonas*

Discussion: The photograph in the question shows a large corneal ulcer depicted by a fluffy stromal infiltrate and an overlying epithelial defect. There are several eti-

ologies of ulcerative keratitis, but infectious causes should be presumed until proven otherwise. Bacterial corneal ulceration is the most common infectious etiology and is often sight-threatening. Virulent pathogens can have a rapid onset and progression that, left untreated, may

progress to perforation. Less frequent infectious causes include fungal, viral, and protozoan.

Case history is important in determining the cause of corneal ulceration. The most frequent risk factor for corneal ulcer in the United States is contact lens wear. This risk increases significantly in patients who sleep in their lenses overnight. Traumatic ocular injuries, particularly from vegetable matter, increase the suspicion of a fungal etiology. Corneal scrapings for Gram stain and culture are paramount in the management of corneal ulcers.

Initial therapy with a broad-spectrum antibiotic is recommended until the offending organism has been identified in culture. Severe cases may require fortified

antibiotics. Contact lens wearers must discontinue their lens wear. Ophthalmologic consultation is required for corneal ulcers since these patients require close outpatient follow-up.

Further reading

1. Charukamnoetkanok P, Pineda R. Controversies in management of bacterial keratitis. *Int Ophthalmol Clin* 2005;45(4): 199–210.
2. Schein OD, Glynn RJ, Poggio EC, et al. The relative risk of ulcerative keratitis among users of daily-wear and extended-wear soft contact lenses. A case-control study. Microbial Keratitis Study Group. *N Engl J Med* 1989;321(12):773–8.

CASE 44 | Suspicious Hand Pain

Answer: C

Diagnosis: Boxer's fracture

Discussion: Fractures of the fifth metacarpal neck are among the most common fractures in the hand, accounting for account for 10% of all hand fractures. These fractures are often caused by striking a solid object with a closed fist and are known as a "boxer's fracture" (Figure 44.1). However, this is a misnomer since these fractures



Figure 44.1 The case X-ray with an arrow pointing to the boxer's fracture.

rarely occur during boxing. Rather, a skilled fighter may fracture the index metacarpal because the blow comes straight from the body along the line of greatest force transmission, while an inexperienced fighter may use a "roundhouse" type motion to cause this injury.

Typically, metacarpal neck fractures will have an apex dorsal angulation (palmar angulation of the distal fragment). Maintaining the fracture in reduction can be difficult due to deforming forces of the surrounding muscles. Metacarpal neck fractures rarely require surgery. Minimally angulated or displaced fractures can be managed with simple immobilization for 3–4 weeks. The degree of acceptable angulation is controversial. Most surgeons agree that no more than 45 degrees of angulation is allowed in the fifth metacarpal. Some authors argue that fifth metacarpal neck fractures with any degree of angulation do not need reduction and may simply be immobilized for 4 weeks. The reasoning behind this is that simple immobilization will not maintain satisfactory reduction. However, rotational injury does need to be addressed as this can impair function and result in a deformity with an overlap of the affected and adjacent fingers. If the decision is to reduce, the most common method of reduction is the 90–90 method. After anesthesia (a hematoma block), traction is applied to the metacarpal distal to the injury. The metacarpophalangeal and interphalangeal joints are then flexed to 90 degrees, and pressure is applied volarly over the metacarpal shaft and dorsally over the flexed proximal interphalangeal (PIP) joint.

The decision to reduce or simply immobilize should be made by an experienced emergency physician or in conjunction with a hand surgeon. Ice, elevation, and

progress to perforation. Less frequent infectious causes include fungal, viral, and protozoan.

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The decision to reduce or simply immobilize should be made by an experienced emergency physician or in conjunction with a hand surgeon. Ice, elevation, and

analgesia are indicated acutely, particularly in the first 48–72 hours. Initial therapy typically consists of an ulnar gutter splint with the arm in position of function (swelling often prevents optimal casting acutely) extending from below the elbow to the PIP joint (but not including the PIP joint). Fractures of the fifth metacarpal should be seen by orthopedic surgery within 1 week of injury.

Further reading

1. Poolman RW, Goslings JC, Lee JB, et al. Conservative treatment for closed fifth (small finger) metacarpal neck fractures. *Cochrane Database Syst Rev* 2005;(3):CD003210.
2. Ashkenaze DM, Ruby LK. Metacarpal fractures and dislocations. *Orthop Clin North Am* 1992;23:19–33.

CASE 45 | Fever and Rash in a Child

Answer: D

Diagnosis: Kawasaki disease (KD)

Discussion: KD disease is an acute, systemic vasculitis occurring in the pediatric population. The majority of cases (80%) occur between the ages of 6 months and 5 years. The peak incidence of KD in epidemiologic studies is about 1–2 years of age. Hospitalization for this disease increases in the United States during the months of December through March. Despite many years of research, the exact etiology of this disease remains unknown. It is currently the most common cause of acquired heart disease in children in the United States. Although the symptoms of KD do reflect a systemic vasculitis, the major complication involves the coronary arteries. This may manifest itself as ectasia (coronary artery inflammation) or coronary artery aneurysms. Without intervention, cardiac sequelae occur in up to 25% of children with KD.

The challenge in the diagnosis of this condition is that it is a clinical diagnosis with no specific, confirmatory laboratory testing. To meet the diagnostic criteria for KD, a patient must have fever for 5 days or more and at least four of the following five clinical symptoms:

1. a polymorphous rash that is characteristically erythematous and maculopapular (not bullous, vesicular, or petechial);
2. inflammatory changes of the lips and mouth including “strawberry” tongue (erythematous with prominent papillae), red lips that are dry and cracked, and diffuse erythema of the oral or pharyngeal mucosa (but no exudate or lesions);
3. bilateral conjunctivitis without exudates;
4. initial edema and erythema of the hands and feet followed later (approximately 2–3 weeks) by skin peeling of the fingers and toes, starting around the nailbed;

5. cervical lymphadenopathy that is typically unilateral and large (>1.5 cm in diameter).

Some of these symptoms may be transient and require a careful history.

Some laboratory findings that have been reported in KD may include:

- elevated acute phase reactants including erythrocyte sedimentation rate and C-reactive protein;
- sterile pyuria;
- elevated platelet count;
- anemia;
- leukocytosis;
- elevated transaminases;
- hypoalbuminemia.

Children with prolonged fever and fewer than four of the classic symptoms may still have coronary artery abnormalities and are considered to have “atypical” or “incomplete” KD. Children less than 1 or older than 4 years of age are more likely to have atypical presentations. There is concern that this group of patients are at greater risk for developing cardiac sequelae. Making the definitive diagnosis in these patients can be a challenge. If incomplete KD is suspected, supportive laboratory data, an echocardiogram to examine for coronary artery abnormalities, and consulting physicians with expertise in Kawasaki’s disease may all be resources used to assist in diagnostic and treatment decisions.

Prompt treatment with intravenous immunoglobulin (IVIG) combined with high doses of aspirin in the acute phase of the illness (generally within 10 days of fever onset) can reduce the risk of coronary artery abnormalities to less than 5%. Administration of IVIG within 10 days of onset of the symptoms offers the best chance of preventing cardiac sequelae. Once persistently afebrile, the amount of aspirin given can be lowered. Lower doses

analgesia are indicated acutely, particularly in the first 48–72 hours. Initial therapy typically consists of an ulnar gutter splint with the arm in position of function (swelling often prevents optimal casting acutely) extending from below the elbow to the PIP joint (but not including the PIP joint). Fractures of the fifth metacarpal should be seen by orthopedic surgery within 1 week of injury.

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of aspirin can be maintained until follow-up echocardiograms have been performed. The exact role and dosing schedule of aspirin in the treatment of these cases is still debated. Approximately 10% of these patients will remain febrile (i.e., refractory) even after one dose of IVIG, and repeat dosing of IVIG or other therapies, such as corticosteroids, may be needed.

Further reading

1. Royle J, Burgner D, Curtis N. The diagnosis and management of Kawasaki disease. *J Paediatr Child Health* 2005;41(3):87–93.
2. Newburger JW, Fulton DR. Kawasaki disease. *Curr Opin Pediatr* 2004;16(5):508–14.

CASE 46 | An Alcoholic with Dyspnea

Answer: E

Diagnosis: Pericardial tamponade

Discussion: Box 46.1 is an overview of the conditions that can be rapidly diagnosed and/or excluded by bedside ultrasound of the thorax and abdomen when confronted by a patient with undifferentiated dyspnea, hypotension, or pulseless electrical activity. Several of these conditions are considerations in the case presented here.

Figures 46.1 and 46.2 are images of the heart showing the left ventricle, the right ventricle, and a large circum-

ferential pericardial effusion (labeled “Eff” in Figure 1, arrow). Effusions are often described as “small/physiologic” when they are noncircumferential, “moderate” when they are circumferential but <10 mm in thickness in diastole, large (10–20 mm in thickness), and very large (>20 mm). Although no caliper measurements have been performed in this case, the centimeter markers along the

Box 46.1 Organs to be investigated and potential diagnoses that may be identified by emergency medicine bedside ultrasound (EMBU) in the evaluation of unexplained hypotension, pulseless electrical activity, or cardiopulmonary arrest

EMBU of the thorax

Pericardium and heart

Effusion ± tamponade, severe hypovolemia, massive pulmonary embolus, cardiogenic shock, myocardial infarction,* gross valvular dysfunction*

Proximal aorta

Proximal dissection*

Pleural spaces

Pneumothorax, massive pleural effusion, massive pulmonary consolidation

EMBU of the abdomen

Inferior vena cava

Severe hypovolemia, massive pulmonary embolus

Abdominal aorta

Abdominal aortic aneurysm, distal dissection*

Peritoneal cavity

Free fluid, pneumoperitoneum*

*Conditions that can be identified but cannot be reliably excluded with EMBU.

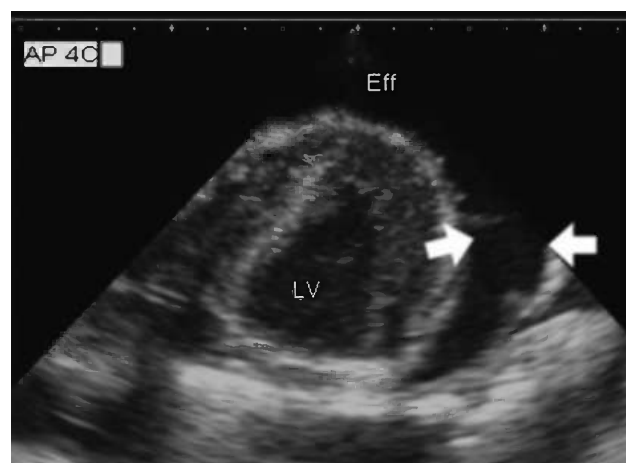


Figure 46.1 Apical four-chamber view. Eff, effusion; LV, left ventricle.

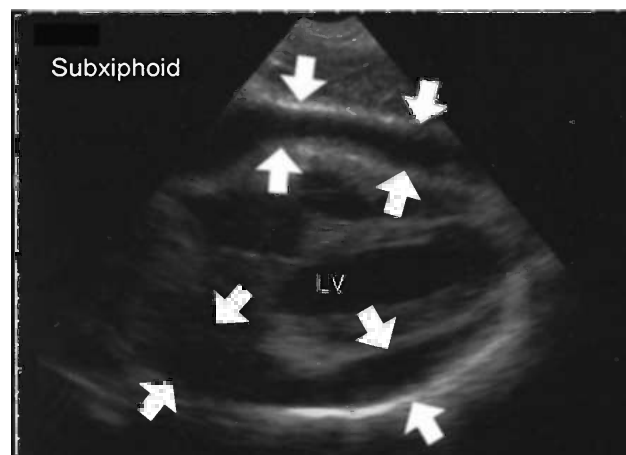


Figure 46.2 Subxiphoid view. LV, left ventricle.

of aspirin can be maintained until follow-up echocardiograms have been performed. The exact role and dosing schedule of aspirin in the treatment of these cases is still debated. Approximately 10% of these patients will remain febrile (i.e., refractory) even after one dose of IVIG, and repeat dosing of IVIG or other therapies, such as corticosteroids, may be needed.

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Proximal aorta

Proximal dissection*

Pleural spaces

Pneumothorax, massive pleural effusion, massive pulmonary consolidation

EMBU of the abdomen

Inferior vena cava

Severe hypovolemia, massive pulmonary embolus

Abdominal aorta

Abdominal aortic aneurysm, distal dissection*

Peritoneal cavity

Free fluid, pneumoperitoneum*

*Conditions that can be identified but cannot be reliably excluded with EMBU.

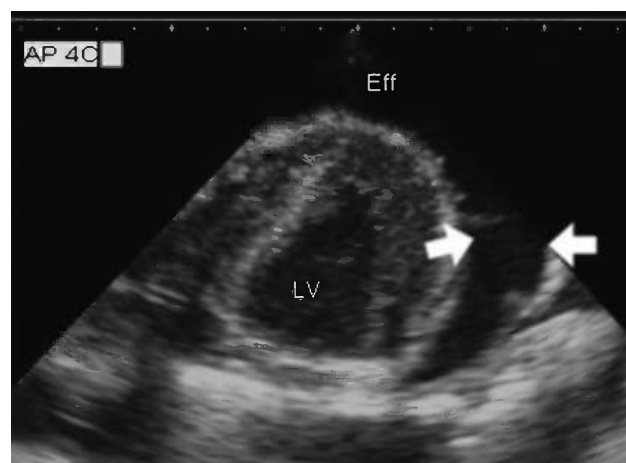


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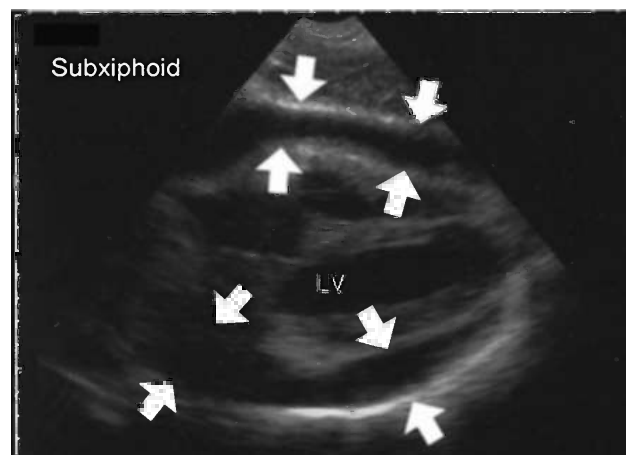


Figure 46.2 Subxiphoid view. LV, left ventricle.



Figure 46.3 Right upper quadrant view. FF, free fluid. *, See text for description.

upper margins of the images indicate that this effusion is as large as 40mm in thickness. Cardiac tamponade is demonstrated in real time by diastolic collapse of any chamber in the presence of a moderate or large effusion.

Figure 46.3 shows a right upper quadrant view similar to that used to identify free fluid in the focused assessment by sonography in trauma (FAST) approach. A very large volume of free fluid can be seen between the liver and kidney (Morison's pouch). While this could conceivably be blood, its uniformity, a complete lack of echogenicity and marked posterior acoustic enhancement (causing artifactually increased echoes from the underlying tissues (marked * in the figure) argue against this fluid being intraperitoneal hemorrhage. With the patient's history of alcohol abuse and the small, hyperechoic liver seen in Figure 3, this fluid is much more likely to be due to ascites.

In Figure 46.4, a longitudinal view of the upper aorta can be seen showing the celiac and superior mesenteric (SMA) trunks. Free fluid is not apparent in this view, probably due to compression. Since 90% of abdominal aortic aneurysms occur between the renal arteries (1 cm inferior to the SMA) and the bifurcation, an aneurysm cannot be excluded based on this view alone. However, there is also no evidence to indicate the presence of an abdominal aortic aneurysm.

To summarize, the ultrasound images suggest a variety of abnormalities, which, typical of the resuscitation setting, need to be prioritized according to both their overall likelihood and potential lethality. The diagnosis that poses the greatest risk of precipitous deterioration is that of cardiac tamponade. It is also the one which would take precedence in management according to the standard emergency medicine priorities of the "ABC's": airway, breathing, and circulation. Beck's triad is a late finding in tamponade, so that its absence does not exclude the possibility of this diagnosis, which should be made prior to the onset of hypotension. While potentially very serious,

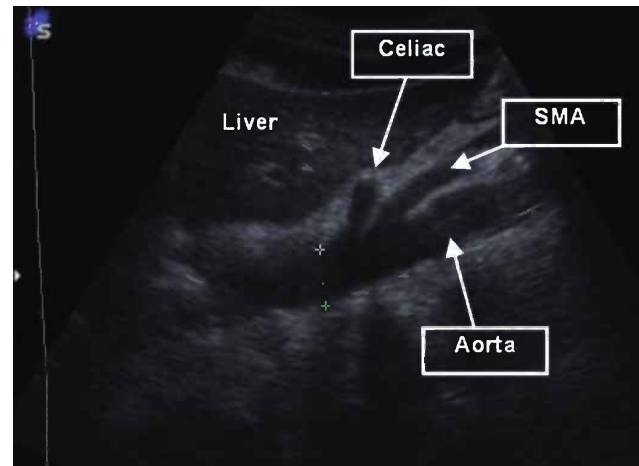


Figure 46.4 Midline sagittal view of abdomen.

intracranial causes of altered mental status are less rapidly lethal than hemodynamic ones, so the latter should be sought and addressed first, especially in a patient with abnormal vital signs such as this one.

With evolving training and experience in bedside sonography, the specialty of emergency medicine has appropriated and integrated a variety of techniques from disparate specialties to provide rapid information about many of the causes of critical illness. Echocardiographic approaches are used in assessing the heart. Techniques developed in critical care are used to assess the pleural spaces and lungs. The methods of FAST are employed to identify free fluid in the potential spaces of the abdomen and thorax; and traditional radiologic techniques are used to assess the great vessels. In this way, bedside ultrasound performed in real time by the treating clinician provides immediate diagnostic information about a range of disease processes, many of which mandate therapies that are specific and mutually exclusive (e.g., volume overload versus hypovolemic shock). Several algorithms have been proposed to formalize this approach.

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1. Reardon RF, Joing SA. Cardiac. In *Emergency Ultrasound*, 2nd edn. Ma OJ, Mateer JR, Blaivas M, eds. New York: McGraw-Hill. 2008:109–48.
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3. Rose JS, Bair AE, Mandavia D, Kinser DJ. The UHP ultrasound protocol: a novel ultrasound approach to the empiric evaluation of the undifferentiated hypotensive patient. *Am J Emerg Med* 2001;19(4):299–302.

Acknowledgement: We thank Anthony J. Dean, MD for his contribution to this case in the previous edition.

CASE 47 | Dark Urine from an Immigrant

Answer: B

Diagnosis: Acute hemolysis secondary to glucose 6-phosphate dehydrogenase deficiency and favism

Discussion: Glucose 6-phosphate dehydrogenase (G6PD) deficiency, the most common human enzymatic disease of red blood cells, is an inherited X-linked disorder with a high prevalence in individuals of African, Middle Eastern, southern European, South-East Asian, and Oceanian descent. It has been suggested that selection for this disorder is based, similarly to that of certain hemoglobinopathies, on the increased resistance to falciparum malaria found in individuals from these traditionally malarious areas who exhibit both G6PD deficiency and favism, rather than those with G6PD deficiency alone. G6PD is involved in the production of NADPH. NADPH maintains glutathione, and other proteins, in the reduced state when erythrocytes are subjected to oxidant stress. Conditions of oxidant stress, including infection, ingestion of drugs with a high redox potential such as the antimalarial primaquine, chloramphenicol, ciprofloxacin, and sulfa drugs, and broad bean (including fava bean) ingestion, produce hemolysis of deficient erythrocytes in susceptible individuals. Favism has also been reported in breast-fed infants of mothers who ate fava beans (*Vicia faba*).

Most individuals who are G6PD-deficient remain clinically asymptomatic. Sequestration of damaged erythrocytes occurs in the liver and spleen. Symptom severity depends on the number of erythrocytes destroyed. Anemia stimulates erythropoiesis, with an increase in more oxidant tolerant reticulocytes in 5 days.

Favism is felt to result from the presence of the beta-glycosides in fava beans, vicine and convicine, and DOPA (3,4-dihydroxyphenylalanine) and its beta-D-glycoside. Vicine and convicine are cleaved by intestinal beta-glucosidase to produce the pyrimidine aglycones divicine and isouramil, which reduce the activity of catalase and lower the concentration of reduced glutathione. This, for unclear reasons, does not produce favism every time affected individuals eat broad beans, but the amount eaten and the degree to which the beans are cooked may be important factors. One study also found decreased serum levels of gammaglobulin and alpha-2-globulin, but increased levels of total serum lipids, total serum cholesterol, and serum bilirubin, in patients with favism compared with their normal control group.

The fall in hemoglobin is acute and often severe, and may be fatal without transfusion. With favism, the spun urine classically shows hemoglobinuria, with 0–1 red blood cells and a clear red supernatant. The blood smear

will show anisocytosis, polychromasia, poikilocytosis, and “blister cells.” Serum hemoglobin (showing a 3–4 g/dL fall) and haptoglobin will be low, while lactate dehydrogenase and unconjugated bilirubin will be elevated.

In this patient, G6PD testing showed decreased enzyme activity. He responded well to transfusion. He was educated regarding oxidant stressors to avoid, and it was suggested that his family members should be tested.

In this patient from Egypt, another important consideration in the differential diagnosis of red urine would be urinary schistosomiasis (bilharziasis), caused by flatworm parasites of the genus *Schistosoma*, class Trematoda. *Schistosoma haematobium* is highly prevalent throughout Africa and parts of the Middle East. Human transmission is waterborne via skin penetration by larval cercariae in urine-contaminated bodies of fresh water that carry competent snail vectors. Once the skin has been penetrated, cercariae travel through the lungs and systemic circulation to lodge in the venous plexus near the urinary bladder and ureters, where they develop into adult worms and pair sexually. The time from cercarial penetration to first ovum production is approximately 4–6 weeks. Adult female worms lay approximately 20–200 terminally spined round eggs per day for the approximately 3–8 years of their lifespan.

Clinical manifestations of schistosomiasis result from the host immune response to the thousands of eggs secreted by the female. In *Schistosoma haematobium* infection, approximately 50% of eggs are excreted into the urine. The remainder lodge in host tissue, typically in the urinary tract, stimulate a granulomatous reaction, and produce dysuria, frequency, and hematuria. Eosinophilia may be seen. Bladder fibrosis and calcification appear late in the disease, and chronic infection is associated with glomerulonephritis, pyelonephritis, obstructive uropathy, and renal failure, and an increased risk of bladder cancer development. In at-risk populations, *Salmonella*-related urinary tract infection suggests underlying schistosomiasis.

Diagnosis is by microscopic identification of eggs in the urine and serologic testing. Serologic testing will not differentiate between active and past infection, and does not quantify egg burden. On ultrasound, bladder wall irregularities, hydroureter, and hydronephrosis may be evident. A diagnostic bladder mucosal biopsy via cystoscopy will visualize eggs, granulomata, and bladder cancer. Praziquantel is the drug of choice for treatment, proving most effective against adult forms of the parasite, and to interrupt transmission in endemic areas. Artemether is showing promise in clinical trials, and vaccine development is in process.

Further reading

1. Bierman W, Wetsteyn JC, van Gool T. Presentation and diagnosis of imported schistosomiasis: relevance of eosinophilia, microscopy for ova, and serology. *J Travel Med* 2005;12:9–13.
2. Corchia C, Balata A, Meloni GF, Meloni T. Favism in a female newborn infant whose mother ingested fava beans before delivery. *J Pediatr* 1995;127:807–8.
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CASE 48 | Chest Pain and Lead aVR ST Segment Elevation

Answer: C

Diagnosis: ST elevation myocardial infarction (STEMI) resulting from left main coronary artery obstructive lesion (as indicated by ST segment elevation in lead aVR)

Discussion: The case ECG revealed ST segment elevation in leads V1 and V2, consistent with anterior wall STEMI; additionally, diffuse ST segment was seen in leads II, III, aVF, and V3–V6. On a secondary review of the ECG, the physician noted ST segment elevation also in lead aVR of approximately 3mm. Based upon the patient's presenting symptoms and signs, the physician diagnosed an anterior wall STEMI with extensive reciprocal ST segment depression (indicating an extensive infarction with a high risk of acute cardiovascular complication and death) and ST elevation in lead aVR (indicating a very high likelihood of left main coronary artery obstruction). Thus, the hospital-based STEMI Alert team was activated. The patient was transferred to the cardiac catheterization laboratory, where percutaneous coronary intervention was performed on a distal left main coronary artery lesion (90% occlusion with thrombus). Cardiac serum markers were elevated, confirming the diagnosis of acute myocardial infarction. The patient was managed appropriately and was discharged after a 4-day hospital course.

It is widely recognized that the rapid diagnosis and management of STEMI can reduce the associated morbidity and mortality. The 12-lead ECG plays a central role in the early diagnosis of STEMI and, near simultaneously, provides the primary indication for the consideration of acute reperfusion therapy – namely ST segment elevation of at least 1–2mm occurring in at least two anatomically oriented leads. Other ECG findings can predict a greater chance of adverse outcome, including reciprocal ST segment depression and isolated ST segment elevation in lead aVR.

ST segment elevation in lead aVR predicts risk likely due to its association with significant left main coronary artery (LMCA) obstruction. The early determination of LMCA obstruction is important. Certain coronary artery obstruction patterns are more appropriately managed with mechanical reperfusion therapies, such as percutaneous coronary intervention (PCI) or coronary artery

bypass grafting. In fact, STEMI resulting from LMCA obstruction is associated with a very high mortality rate and is most appropriately managed with reperfusion strategies other than fibrinolysis. In fact, STEMI resulting from a LMCA obstruction is associated with a 70% mortality rate if managed with fibrinolysis. PCI can markedly reduce this high mortality rate – the importance of early recognition of LMCA obstruction in STEMI and other significant ACS presentations.

This finding is important in that such obstruction is associated with a markedly higher mortality rate and may be more amenable to mechanical reperfusion strategies rather than fibrinolysis. Numerous investigators have noted this association between lead aVR ST segment elevation and LMCA obstruction. Yamaji noted the relationship between acute LMCA obstruction and ST segment elevation greater than 0.05 mV in lead aVR – this finding was noted in 88% of patients with LMCA obstruction compared with 8–43% of patients with other, non-LMCA obstructive lesions. Rostoff determined that ST segment elevation in lead aVR was two times more common in the patient population with LMCA involvement. Kosuge, using multivariate analysis of the ECG findings, determined ST segment elevation greater than 0.5mm in lead aVR to be the strongest predictor of LMCA or its equivalent, three-vessel coronary artery disease.

Furthermore, such an electrocardiographic finding is associated with a significant risk of short-term adverse events. In another study, Kosuge determined that ST segment elevation greater than 0.5mm in lead aVR on the admission ECG and elevated troponin T levels were determined to be independent predictors of adverse clinical events at 90 days, with an odds ratio of 13.8 and 7.9, respectively. Barrabes has found that in-hospital mortality increased in a stepwise fashion across increasing increments of ST segment elevation in lead aVR: 1.3% of the 525 patients without ST segment elevation in lead aVR died, while 8.6% of the 116 patients with 0.05–0.1 mV of elevation died, as did 19.4% of the 134 patients with greater than 0.1 mV elevation.

Thus, ST segment elevation in lead aVR in the patient with clinically suspected ACS suggests a strong possibility

Further reading

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Thus, ST segment elevation in lead aVR in the patient with clinically suspected ACS suggests a strong possibility

of LMCA obstruction and a significant risk of short-term adverse outcome. The early recognition of this finding within the greater subset of patients with ACS can allow for earlier definitive therapy in this high-risk patient population.

Further reading

1. Kosuge M, Kimura K, Ishikawa T. Combined prognostic utility of ST segment in lead aVR and troponin T on admission in

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CASE 49 | Hand Pain after Striking a Wall

Answer: C

Diagnosis: Carpometacarpal dislocation of the fourth and fifth metacarpals

Discussion: The carpometacarpal (CMC) joints are extremely stable due to significant bony and ligamentous support. As a result, isolated dislocations are not common, but they can occur. Typically, dislocations result from significant trauma (e.g., a motor vehicle accident or direct blow to the hand) and are often associated with fractures of the base of the metacarpal. The fourth and fifth metacarpals are the most common sites of injury due to a greater degree of motion and related laxity.

While tenderness is usually significant, the deformity of the dislocated joint is often obscured by significant soft tissue swelling present on the dorsum of the hand. An obvious step-off deformity may be observed and/or palpated at the level of the dislocation (the proximal metacar-

pal as it overrides the distal carpus), particularly if the patient presents early before dramatic swelling develops.

The neurovascular status of the hand should be carefully assessed in these injuries. Specific attention should be directed to the status of the deep branch of the ulnar nerve in that it lies immediately volar to the fifth CMC joint. The median nerve may also be injured. Vascular compromise, particularly in patients with injury to the third metacarpal, may involve the deep palmar arterial arch, which lies directly beneath the third CMC joint. Integrity of the wrist extensor tendons must be assessed in these dislocation injuries as disruption may occur. Additionally, patients who have suffered a direct blow are at risk for compartment syndrome in the hand.

The anteroposterior radiograph view may reveal an overlap of the carpal bones over the proximal metacarpals (Figure 49.1A, arrows). The lateral radiograph often is



Figure 49.1 A. Anteroposterior view of the hand and wrist. Note the lack of joint space between the carpus and the fourth and fifth metacarpals. B. Lateral view of the hand and wrist. Note the dorsal overlap of the fourth and fifth metacarpals over the carpus. This view is the most useful in establishing the diagnosis of carpometacarpal dislocation.

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Treatment in the emergency department consists of closed reduction, which can be accomplished with longitudinal traction. The hand should then be splinted; digital motion should be encouraged to prevent stiffness associated with swelling. Orthopedic consultation is necessary as these dislocations often require percutaneous pinning or open reduction with internal fixation.

Further reading

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2. Griffiths MA, Moloney DM, Pickford MA. Multiple carpometacarpal dislocations after a low-impact injury: a missed diagnosis. *J Trauma* 2005;58:391–2.

CASE 50 | A Refugee with Skin Lesions

Answer: A

Diagnosis: Coining

Discussion: The skin changes seen here are typical of “coining,” a common practice in many Asian cultures. Referred to as Cao Gio (“scratch the wind”) in Vietnamese, this practice is a folk remedy intended to treat fevers, headache, and other maladies by enabling the release of “bad winds” from the body. Coining can mimic physical abuse and is of great concern to many practitioners who are unaware of the benign nature of this cultural practice. The remedy produces linear micro-ecchymoses as a result of rubbing a coin on oiled skin. These erythematous, striped lesions generally last 1 or 2 weeks but can transition into lasting areas of hyperpigmentation.

In addition to coining, there are many other culturally specific practices that can result in striking patterned ecchymosis. “Cupping” is performed by placing an alcohol-soaked cotton ball inside a glass cup. This cotton ball is then ignited, causing the glass to heat and evacuate oxygen. When the cotton ball is removed, the cup is placed immediately on the skin, creating a vacuum. This results in circular ecchymotic areas that can mimic bruises but for their rounded appearance. This remedy is also practiced in Chinese as well as other Asian communities. It is believed to bring toxins from deep in the body to the skin to be released. Other therapies such as moxibustion involve burning certain herbs (*Artemisia* or mugwort) near the skin to warm the area and to improve circulation.

“Herbal therapists” in the United States have also adopted some of these practices.

Despite the benign intent of these therapies, some of these cultural remedies can inadvertently cause harm. Thermal burns can result from cupping and moxibustion. Additionally, salting, another Asian folk remedy, can result in hypernatremia. Uvulectomy, as practiced in several African countries, can lead to infection, as can the small, deep, therapeutic burns known as maqas that are part of a traditional Arabic therapy.

To avoid alienating the patient or family, it is essential to evaluate these patients with an open-minded, nonjudgmental approach and an appreciation for the deep-rooted beliefs of these cultures. Integrating these practices along with Western approaches (e.g., acetaminophen for fever) will lead to the best care for the patient.

Further reading

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3. Crutchfield CE, Bisig TJ. Coining. *N Engl J Med* 1995;332(23):1552.

CASE 51 | Pain out of Proportion to Examination

Answer: C

Diagnosis: Clostridial myonecrosis (gas gangrene)

Discussion: Clostridial myonecrosis, more commonly known as gas gangrene, is a surgical emergency. Exotoxins,

produced under anaerobic conditions, are responsible for morbidity and mortality associated with clostridial myonecrosis. These toxins result in numerous detrimental effects, including lysis of muscle cells, destruction of

diagnostic, with obvious dislocation of the CMC joint visualized without difficulty (Figure 49.1B, arrows). A critical issue in the evaluation of CMC dislocations is the recognition of associated metacarpal fractures.

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Despite the benign intent of these therapies, some of these cultural remedies can inadvertently cause harm. Thermal burns can result from cupping and moxibustion. Additionally, salting, another Asian folk remedy, can result in hypernatremia. Uvulectomy, as practiced in several African countries, can lead to infection, as can the small, deep, therapeutic burns known as maqas that are part of a traditional Arabic therapy.

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produced under anaerobic conditions, are responsible for morbidity and mortality associated with clostridial myonecrosis. These toxins result in numerous detrimental effects, including lysis of muscle cells, destruction of

blood vessels, hemolysis, and cardiovascular collapse. *Clostridium perfringens* is the most common of all the clostridial species capable of producing gas gangrene. However, *C. perfringens* is one of the most rare pathogens responsible for necrotizing soft tissue infections (NSTIs). NSTI is a term that more broadly describes the process of soft tissue destruction caused by various types of bacteria. NSTI is most commonly polymicrobial. Regardless of the inciting agent, the same diagnostic and therapeutic approach to NSTIs is used. Predisposing factors for the development of NSTIs are diabetes mellitus, immunosuppression, intravenous drug use, and chronic kidney disease.

The clinical picture can initially appear benign, necessitating a high degree of clinical suspicion to confirm the diagnosis. Pain is rapidly progressive over hours to days and is typically out of proportion to physical findings. As the tissue destruction worsens, the patient may even become numb in the affected area. Classically described symptoms include pain, anxiety, and diaphoresis, but the most common signs are erythema and swelling. While a low-grade fever is occasionally present, it is typically lower than would be expected given the severity of the infection. The patient may offer a history of traumatic injury, but many reported cases have no identifiable etiology.

The wound itself is usually unimpressive, with surrounding pale tissue. In later stages, the wound can appear dusky and progress to dark discoloration. The wound may have foul-smelling, brown discharge, often described as “dishwater” material with a positive “finger test”. The finger test is performed by inserting a finger into the wound and rotating it 360 degrees. As a result of loss of tissue integrity, the finger moves through the tissue without resistance. The wound discharge should be sent for culture and Gram stain; clostridial infections typically reveal a preponderance of Gram-positive rods and a lack of neutrophils. Gas in the soft tissues can manifest clinically as crepitus.

Radiographic evidence of air in the soft tissues suggests the diagnosis (as noted in the X-ray of this case) but may be absent. Some authors advocate sonography as a tool to identify gas in the wound before it is clinically apparent or before it is visible on plain radiographs. Computed tomography is more sensitive for both deeper fascial gas and inflammatory changes within the tissues. Magnetic resonance imaging can assist in confirming the diagnosis or suggesting an alternative diagnosis. The gold standard for diagnosis is the intraoperative findings with surgical exploration.

Once the diagnosis is entertained, broad-spectrum antibiotic therapy should be initiated immediately. Empiric drug regimens consist of mono- or triple drug therapy but must provide Gram-positive, Gram-negative, and anaerobic coverage until the causative agent has been identified. Emergent surgical evaluation is essential, and prolonged time to debridement has been shown to be predictive of higher mortality. Usually, multiple surgeries may be needed to ensure adequate debridement. Radical excision and amputation are sometimes necessary to prevent mortality. Aggressive fluid resuscitation should be initiated in the emergency department as hypotension and septic shock can be encountered. Intravenous immune globulin treatment may be a future option in critically ill patients, but its efficacy has not yet been proven. Hyperbaric oxygen (HBO) therapy may be an adjuvant therapy but has not been proven to offer any benefit. HBO should not supplant immediate surgical care, antibiotics, and fluid resuscitation.

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1. Sarani B, Strong M, Pascual J, Schwab W. Necrotizing fasciitis: current concepts and review of the literature. *J Am Coll Surg* 2009;208(2):279–88.
2. Anaya DA, Dellinger EP. Necrotizing soft-tissue infection: diagnosis and management. *Clin Infect Dis* 2007;44(1):705–10.

CASE 52 | Leg Pain Following a Motor Vehicle Collision

Answer: D

Diagnosis: Left hip fracture

Discussion: This patient has a left hip fracture. The term “hip fracture” most often refers to femoral fractures from the femoral head to the subtrochanteric area; however, the term is occasionally applied to acetabular fractures. Displaced fractures of the femoral neck and intertrochanteric fractures cause the classic physical examination findings seen in this case consisting of shortening and

external rotation of the lower extremity. While examining the lower extremity, careful attention should be focused on the neurovascular examination as sciatic or femoral nerve or arterial injury can occur with these fractures.

The patient’s X-ray in this case is shown here (Figure 52.1).

The X-ray reveals that this patient has sustained an intertrochanteric fracture of the left femur. In younger adults, this injury typically occurs after a high-speed

blood vessels, hemolysis, and cardiovascular collapse. *Clostridium perfringens* is the most common of all the clostridial species capable of producing gas gangrene. However, *C. perfringens* is one of the most rare pathogens responsible for necrotizing soft tissue infections (NSTIs). NSTI is a term that more broadly describes the process of soft tissue destruction caused by various types of bacteria. NSTI is most commonly polymicrobial. Regardless of the inciting agent, the same diagnostic and therapeutic approach to NSTIs is used. Predisposing factors for the development of NSTIs are diabetes mellitus, immunosuppression, intravenous drug use, and chronic kidney disease.

The clinical picture can initially appear benign, necessitating a high degree of clinical suspicion to confirm the diagnosis. Pain is rapidly progressive over hours to days and is typically out of proportion to physical findings. As the tissue destruction worsens, the patient may even become numb in the affected area. Classically described symptoms include pain, anxiety, and diaphoresis, but the most common signs are erythema and swelling. While a low-grade fever is occasionally present, it is typically lower than would be expected given the severity of the infection. The patient may offer a history of traumatic injury, but many reported cases have no identifiable etiology.

The wound itself is usually unimpressive, with surrounding pale tissue. In later stages, the wound can appear dusky and progress to dark discoloration. The wound may have foul-smelling, brown discharge, often described as “dishwater” material with a positive “finger test”. The finger test is performed by inserting a finger into the wound and rotating it 360 degrees. As a result of loss of tissue integrity, the finger moves through the tissue without resistance. The wound discharge should be sent for culture and Gram stain; clostridial infections typically reveal a preponderance of Gram-positive rods and a lack of neutrophils. Gas in the soft tissues can manifest clinically as crepitus.

Radiographic evidence of air in the soft tissues suggests the diagnosis (as noted in the X-ray of this case) but may be absent. Some authors advocate sonography as a tool to identify gas in the wound before it is clinically apparent or before it is visible on plain radiographs. Computed tomography is more sensitive for both deeper fascial gas and inflammatory changes within the tissues. Magnetic resonance imaging can assist in confirming the diagnosis or suggesting an alternative diagnosis. The gold standard for diagnosis is the intraoperative findings with surgical exploration.

Once the diagnosis is entertained, broad-spectrum antibiotic therapy should be initiated immediately. Empiric drug regimens consist of mono- or triple drug therapy but must provide Gram-positive, Gram-negative, and anaerobic coverage until the causative agent has been identified. Emergent surgical evaluation is essential, and prolonged time to debridement has been shown to be predictive of higher mortality. Usually, multiple surgeries may be needed to ensure adequate debridement. Radical excision and amputation are sometimes necessary to prevent mortality. Aggressive fluid resuscitation should be initiated in the emergency department as hypotension and septic shock can be encountered. Intravenous immune globulin treatment may be a future option in critically ill patients, but its efficacy has not yet been proven. Hyperbaric oxygen (HBO) therapy may be an adjuvant therapy but has not been proven to offer any benefit. HBO should not supplant immediate surgical care, antibiotics, and fluid resuscitation.

Further reading

1. Sarani B, Strong M, Pascual J, Schwab W. Necrotizing fasciitis: current concepts and review of the literature. *J Am Coll Surg* 2009;208(2):279–88.
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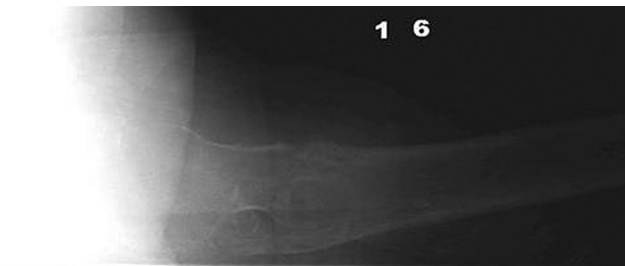


Figure 52.1 Intertrochanteric fracture of the left femur.

motor vehicle crash or a fall from a height. A significant force is required to cause this fracture, resulting in associated injuries and fractures in up to 50% of patients. In these cases, fractures of the femoral neck are associated with fractures of the femoral shaft in 20% of patients. In older patients, hip fractures can occur after a fall of any type and are associated with an age-related decrease in bone density. Occult fracture may be suggested by the inability to flex the hip or bear weight as well as pain with internal or external rotation.

A complete trauma evaluation must be performed. The patient may be distracted by pain secondary to the hip fracture and unaware of other injuries. Femur fractures can result in the loss of 2–3 units of blood into the thigh

and cause hemodynamic instability. The physician must rule out other potential sources of hemodynamic instability before attributing blood loss to the hip fracture alone. Complete trauma evaluation must be the first priority, and then orthopedic consultation can be obtained. Fixation is usually performed on an urgent, not emergent basis.

Hip fractures can have a subtle appearance on X-ray, particularly in osteopenic bone. Occult fractures of the hip may not be seen on up to 10% of plain film radiography. If there is a suspicion of occult fracture, magnetic resonance imaging (MRI) is more sensitive than computed tomography, making MRI the diagnostic study of choice.

Further reading

1. Cannon J, Silvestri S, Munro M. Imaging choices in occult hip fracture. *J Emerg Med* 2009;37(2):144–52.
2. Rudman N, McIlmail D. Emergency department evaluation and treatment of hip and thigh injuries. *Emerg Med Clin North Am* 2000;18(1):29–66.

Acknowledgement: We thank Jane M. Prosser, MD for her contribution to this case in the previous edition.

CASE 53 | Deformed Globe Following Trauma

Answer: D

Diagnosis: Globe rupture

Discussion: Any injury that violates the integrity of the cornea or sclera by perforation, penetration, or intraocular foreign body constitutes an open-globe injury. Globe rupture represents an ophthalmologic emergency, and management is surgical in practically all cases. When the mechanism of injury or the examination findings are concerning for globe rupture, appropriate treatment should be initiated and continued until the diagnosis has been reliably excluded.

A history of blunt trauma to the orbital region with an examination showing total hyphema (also called eight-ball or blackball hyphema), severe subconjunctival hemorrhage, and limited extraocular muscle mobility suggests serious intraocular injury. Other findings suggestive of globe rupture or an open-globe injury include a peaked or irregular pupil (the apex pointing towards the injury; Figure 53.1), scleral buckling, intraocular contents found outside the globe, full-thickness scleral or corneal lacerations, prolapse or distortion of the iris, traumatic cataract, traumatic lens subluxation or dislocation, either a shallow or deep anterior chamber (compared with the other side), vitreous hemorrhage, and enophthalmos or exophthal-



Figure 53.1 Indications of a ruptured globe: a “peaked” pupil without an afferent pupillary defect, mild conjunctival chemosis, a corneal laceration with prolapsed iris tissue, and a shallow anterior chamber.

mos (with associated retrobulbar hemorrhage). The appearance of an ooze of fluorescent fluid, under cobalt-blue light, from the corneal surface after fluorescein staining represents an aqueous humor leak from a full-thickness

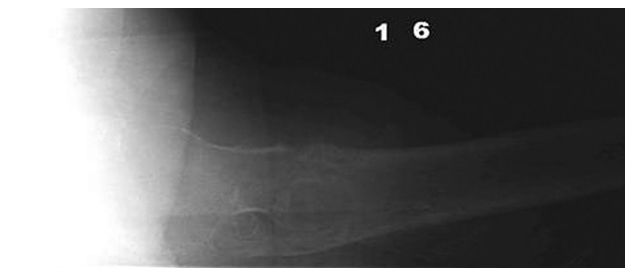


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A complete trauma evaluation must be performed. The patient may be distracted by pain secondary to the hip fracture and unaware of other injuries. Femur fractures can result in the loss of 2–3 units of blood into the thigh

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mos (with associated retrobulbar hemorrhage). The appearance of an ooze of fluorescent fluid, under cobalt-blue light, from the corneal surface after fluorescein staining represents an aqueous humor leak from a full-thickness

injury (positive Seidel test). Occupational or recreational exposures involving metals, plastics, or wood with eye injuries or a history of penetrating trauma to the head or face with ocular injury should raise suspicion for a globe injury.

Management of suspected globe rupture begins with protection of the injured eye with a rigid shield. It is critical to avoid putting any pressure on or around the globe to minimize the chance for extrusion of the intraocular contents. Therefore soft patches, as well as measurements of intraocular pressure, are contraindicated when considering a globe rupture. Ocular ultrasound is also contraindicated when a globe rupture is suspected. Once the diagnosis is entertained, no further palpation or manipulation of the affected eye should be undertaken until the patient has been examined by ophthalmology. Prophylactic antibiotics should be started as soon as an open-globe injury is considered, in order to reduce the rate of subsequent endophthalmitis. Antibiotic should cover Gram-

positive organisms, skin flora, *Pseudomonas*, and anaerobic organisms. Intravenous cefazolin and a fluoroquinolone have good antimicrobial coverage and intraocular penetration, and are considered reasonable initial treatment selections. In children, an aminoglycoside plus cefazolin is recommended. Tetanus updates, analgesics, and antiemetics should be given to avoid Valsalva maneuvers with associated increased intraocular pressure. Computed topography scanning of the orbits is the most sensitive and accessible imaging study to diagnose rupture, detect foreign bodies, and visualize the relevant anatomy.

Further reading

1. Bord SP, Linden J. Trauma to the globe and orbit. *Emerg Med Clin North Am* 2008;26:97–123.
2. Pokhrel PK, Loftus SA. Ocular emergencies. *Am Fam Physician* 2007;76(6):829–36.

CASE 54 | Foot Pain Following Breaking

Answer: B

Diagnosis: Lisfranc fracture (medial cuneiform and second metatarsal base fracture with lateral displacement of the second to fifth metatarsals)

Discussion: The tarsometatarsal joint is named after Jacques Lisfranc, a French physician in Napoleon's army who first described amputations through this joint. Any injury to this joint, from sprain to fracture, is termed a Lisfranc injury. Lisfranc injuries are uncommon because of the high force that is required to disrupt this joint. Lisfranc injuries can occur as a result of rotation of the body on a fixed forefoot, axial loading, or crush injuries. Although motor vehicle collisions are usually the mechanism, up to one-third of Lisfranc injuries arise from patients stumbling and/or falling.

The clinical presentation of a Lisfranc fracture includes severe midfoot pain, inability to bear weight, and paresthesias. Examination often reveals edema, ecchymosis, and midfoot tenderness. Patients with severe injuries may have obvious deformity of the midfoot with forefoot displacement. Vascular injury may occur because a branch of the dorsalis pedis artery dives between the first and second metatarsal, forming the plantar arch. Injury to this vessel is uncommon but can lead to hemorrhage, vascular compromise, and compartment syndrome. Radiographic

findings suggestive of a Lisfranc injury include widening between the first and second or second and third metatarsal bases. In addition, any fracture involving the Lisfranc joint (base of the metatarsals, cuboid, and cuneiforms) should raise suspicion for joint disruption. A fracture involving the second metatarsal base is virtually pathognomonic for Lisfranc joint injury.

Management of a Lisfranc fracture is operative and requires orthopedic consultation. The patient requires serial vascular checks; however, an angiogram is only necessary if there is clinical evidence of vascular compromise. Although rapid reduction of the displaced metatarsals is desirable, the patient does not require emergent reduction as the fracture does not compromise skin or vascular structures.

Further reading

1. Coetzee JC. Making sense of Lisfranc injuries. *Foot Ankle Clin* 2008;13(4):695–704.
2. Perron AD, Brady WJ. Evaluation and management of the high-risk orthopedic emergency. *Emerg Med Clin North Am* 2003;21(1):159–204.

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CASE 55 | Lamp Oil Ingestion

Answer: D

Diagnosis: Hydrocarbon ingestion/aspiration

Discussion: Accidental ingestion and aspiration of hydrocarbons is a potentially fatal childhood poisoning. The likelihood of aspiration and subsequent severe lung injury correlates with the chemical properties of the agent ingested, including the surface tension, viscosity, and volatility. Low surface tension permits the hydrocarbon to spread rapidly on contact with the respiratory tract. A low viscosity leads to deeper, distal penetration of the fluid into the respiratory tract. High volatility is thought to be damaging in two ways. First, by replacing alveolar gas with its gaseous form, the hydrocarbon can cause hypoxemia. Second, by rapid systemic absorption, entry into the central nervous system can cause neurologic symptoms.

Clinical presentation varies in hydrocarbon exposures. Pediatric patients who are suspected to have ingested a hydrocarbon should be observed closely. If no symptoms occur in 6–8 hours, they are unlikely to develop, and discharge can be considered. Gastrointestinal signs and symptoms can occur as a result of mucosal irritation and can include abdominal pain, nausea, vomiting, and diarrhea. Neurologic symptoms are also common and can include dizziness, euphoria, visual disturbances, seizures, and coma.

However, the respiratory sequelae are typically the most concerning issue in hydrocarbon exposures. Initial proximal airway irritation can cause choking and coughing. With lower airway involvement, tachypnea, crackles, wheezes (bronchospasm), decreased breath sounds, retractions, grunting, and nasal flaring can develop. Fever

resulting from pulmonary injury is common. Lower respiratory symptoms and fever may develop quickly (within 30 minutes) or may be delayed for several hours. Persistent or worsening respiratory problems should be evident within 6–8 hours of the exposure. Chest radiograph findings can occur as early as 30 minutes after aspiration, with nearly all manifesting within 12 hours. Initial findings can include alveolar infiltrates extending from the perihilar regions to involve any segment, but they predominantly involve the lower lobes. Other findings include pulmonary edema, atelectasis, and consolidation.

Persistent respiratory distress mandates admission and close observation. Treatment is largely supportive with oxygen. Bronchodilators can be used for suspected bronchospasm, but there are few conclusive data that show clear efficacy. Gastric lavage is strictly contraindicated because of the risk of inducing vomiting and causing further aspiration. Activated charcoal has not been shown to bind these substances effectively and may also lead to vomiting. Prophylactic antibiotics and steroids have not been shown to be useful or effective in the acute phase of hydrocarbon exposures.

Further reading

1. Victoria MS, Nangia BS. Hydrocarbon poisoning: a review. *Pediatr Emerg Care* 1987;3(3):184–6.
2. Truemper E, Reyes de la Rocha S, Atkinson SD. Clinical characteristics, pathophysiology, and management of hydrocarbon ingestion: case report and review of the literature. *Pediatr Emerg Care* 1987;3(3):187–93.

CASE 56 | Intermittent Abdominal Pain in a Female

Answer: D

Diagnosis: Acute cholecystitis

Discussion: The images (Figure 56.1) show a small shadowing gallstone in the gallbladder neck in the left image (arrowheads), and a large gallstone in the fundus in the right image (calipers). The centimeter markers along the top reveal the gallbladder wall (left image, thin straight arrows and calipers) to be approaching a centimeter in thickness (the upper limit of normal being 3 mm in a noncontracted gallbladder).

The cause of a thickened gallbladder wall is nonsurgical in more than 50% of cases and is most commonly caused by edematous states such as liver disease, renal

disease, and congestive heart failure. In these cases, wall thickening is typically uniform throughout the gallbladder, and the wall should maintain its structural integrity, with a characteristic well-defined trilaminar structure of two relatively hyperechoic layers (serosa and mucosa) separated by the thicker hypoechoic muscularis layer. In contrast, the current images show heterogeneous areas of focal edema scattered through the wall (large arrows), with irregular wall thickening and areas of frank mucosal breakdown (short wide arrows). All these findings are suggestive of an acute inflammatory process which, combined with the presence of gallstones, is almost certainly acute cholecystitis.

CASE 55 | Lamp Oil Ingestion

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CASE 56 | Intermittent Abdominal Pain in a Female

Answer: D

Diagnosis: Acute cholecystitis

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Figure 56.1 Ultrasound images revealing a small shadowing gallstone in the gallbladder neck in the left image (arrowheads) and a large gallstone in the fundus in the right image (between the calipers, denoted by +). The centimeter markers along the top reveal the gallbladder wall (left image, thin straight arrows and calipers) to be approaching a centimeter in thickness. RUQ, right upper quadrant; Sag, sagittal.

In the ambulatory setting, cholecystitis rarely occurs without gallstones. The most accurate diagnostic study for the detection of gallstones is ultrasound. A recent study by Summers and colleagues demonstrates that emergent physician-performed right upper quadrant ultrasound yields similar accuracy to formal ultrasound for the diagnosis of acute cholecystitis. The rapidity of this examination makes it an ideal tool in the emergency setting. In contrast to the presence or absence of gallstones, sonographic findings of cholecystitis can be relatively subtle. The examiner must also check for the presence of a sonographic Murphy's sign: tenderness elicited by direct probe pressure over the gallbladder, with absence of tenderness when pressure is applied elsewhere on the abdomen. Nuclear scintigraphy is more accurate in the diagnosis of cholecystitis, but it can overlook stones caused by resolved biliary colic and is not readily available in most emergency departments. Oral cholecystography and endoscopic retrograde cholangiopancreatography are not practical in the emergency department setting.

Several studies have shown that the clinical examination is inaccurate in the identification of biliary colic, and in the differentiation between colic and cholecystitis. While the majority of patients with biliary disease have some combination of upper abdominal pain, nausea,

vomiting, fever, right upper quadrant tenderness, and leukocytosis, many patients with these symptoms do not have biliary disease. Biliary pain commonly occurs in the right upper quadrant, but it can occur in the midepigastrium; symptoms typically last 6–24 hours. Patients most commonly describe biliary pain as “steady” in character, not “colicky.” Pain that occurs “in waves” is much more likely to be *non-biliary* in origin. It reaches peak intensity soon after onset and gradually subsides thereafter. Many patients with proven cholecystitis (based on pathology or nuclear scintigraphy) do not have fever or leukocytosis.

Further reading

1. Summers SM, Scruggs W, Menchine MD, et al. A prospective evaluation of emergency department bedside ultrasonography for the detection of acute cholecystitis. *Ann Emerg Med* 2010;56(2):114–22.
2. Gaspari RJ, Dickman E, Blehar D. Learning curve of bedside ultrasound of the gallbladder. *J Emerg Med* 2009;37(1):51–6.
3. Trowbridge RL, Rutkowski NK, Shojania KG. Does this patient have cholecystitis? *JAMA* 2003;289(1):80–6.

Acknowledgement: We thank Anthony J. Dean, MD for his contribution to this case in the previous edition.

CASE 57 | Hallucinations in a Botanist

Answer: A

Diagnosis: Anticholinergic syndrome from Jimson weed (*Datura stramonium*)

Discussion: The physical examination is consistent with anticholinergic poisoning. In this particular case, the

patient ingested a tea brewed from Jimson weed (*Datura stramonium*) seeds. Jimson weed seeds contain both scopolamine and atropine, with atropine (in concentrations of 0.06g atropine per seed) predominating as the plant matures. This plant has been used since colonial times as



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Further reading

1. Summers SM, Scruggs W, Menchine MD, et al. A prospective evaluation of emergency department bedside ultrasonography for the detection of acute cholecystitis. *Ann Emerg Med* 2010;56(2):114–22.
2. Gaspari RJ, Dickman E, Blehar D. Learning curve of bedside ultrasound of the gallbladder. *J Emerg Med* 2009;37(1):51–6.
3. Trowbridge RL, Rutkowski NK, Shojania KG. Does this patient have cholecystitis? *JAMA* 2003;289(1):80–6.

Acknowledgement: We thank Anthony J. Dean, MD for his contribution to this case in the previous edition.

CASE 57 | Hallucinations in a Botanist

Answer: A

Diagnosis: Anticholinergic syndrome from Jimson weed (*Datura stramonium*)

Discussion: The physical examination is consistent with anticholinergic poisoning. In this particular case, the

patient ingested a tea brewed from Jimson weed (*Datura stramonium*) seeds. Jimson weed seeds contain both scopolamine and atropine, with atropine (in concentrations of 0.06g atropine per seed) predominating as the plant matures. This plant has been used since colonial times as

both an herbal medicine and a drug of abuse. The majority of poisonings occur among youths attempting to use the plant for its hallucinogenic properties. Onset of effects typically begins within several hours of seed ingestion.

Anticholinergic toxicity can cause confusion, agitation, hallucinations, anhydrosis, mydriasis, cycloplegia, tachycardia, fever, hypertension, urinary retention, and ileus. An intoxicated individual is colloquially described as “Mad as a hatter, red as a beet, dry as a bone, blind as a bat, and hot as a hare.” A key clinical feature that differentiates this anticholinergic syndrome from sympathomimetic toxicity is the absence of sweating, presence of urinary retention, and loss of bowel sounds. Anticholinergic drugs or plants, and atropine in particular, competitively bind to and block the muscarinic receptors both peripherally and centrally. The differential diagnosis for the anticholinergic syndrome is broad and includes multiple plants, mushrooms, and pharmaceutical drugs with anticholinergic properties (e.g., diphenhydramine and phenothiazines).

The majority of anticholinergic poisonings typically have good outcomes with supportive care consisting of fluid resuscitation, placement of a nasogastric tube for an ileus, and benzodiazepines for agitation. Activated

charcoal may be beneficial if used within several hours after consumption. The use of physostigmine, an acetylcholinesterase inhibitor, is controversial and should be used in consultation with local toxicology experts. In extreme cases of poisoning with anticholinergic agents, patients can develop rhabdomyolysis, marked hyperthermia, visual hallucinations, and extreme agitation.

Anticholinergic agents may interfere with receptors other than just muscarinic receptors. For example, cyclic antidepressants inhibit cardiac sodium channels causing prolongation of the QRS complex, phenothiazines inhibit cardiac potassium efflux channels causing QT prolongation, and diphenhydramine inhibits histamine receptors resulting in seizures.

Further reading

1. Froberg B, Ibrahim D, Furbee RB. Plant poisoning. *Emerg Med Clin North Am* 2007;25:375–433.
2. Richardson WH III, Slone CM, Michels JE. Herbal drugs of abuse: an emerging problem. *Emerg Med Clin North Am* 2007;25:435–57.
3. Dyer S. Plant exposures: wilderness medicine. *Emerg Med Clin North Am* 2004;22(2):299–313.

CASE 58 | Altered Mental Status with an Abnormal Electrocardiogram

Answer: D

Diagnosis: Hyperkalemia

Discussion: The ECG (Figure 58.1) reveals a wide complex rhythm with an irregular rate. Upon review of the medical record, a history of chronic renal failure with hemodialysis was noted; laboratory analysis confirmed the suspicion for hyperkalemia with a serum potassium of 8.3mEq/dL. With this history and laboratory result, the ECG diagnosis of the wide complex rhythm – with a sine wave configuration – is sinoventricular rhythm due to hyperkalemia. While the laboratory results do, in fact, confirm the diagnosis, the clinician should consider this diagnostic possibility based upon the initial ECG rhythm.

Hyperkalemia, a common life-threatening metabolic emergency, is most often diagnosed in patients with renal failure. Hyperkalemia may present with lethargy and weakness as the sole manifestation. Alternatively, the patient may demonstrate significant electrocardiographic abnormality in addition to the mental status and constitutional signs. Both ECG morphologic and rhythm findings are seen in these patients; a subset of these patients, those with widening of the QRS complex, are at significant risk for decompensation and death. While serum

chemistry analysis is the primary diagnostic investigation, the syndrome is suggested with certain electrocardiographic findings, including prominent T waves and widened QRS complexes. In fact, because of the potential delay in laboratory analysis, prompt diagnosis of life-threatening hyperkalemia can be made by the ECG.

From a pathophysiologic perspective, increasing potassium levels are associated with depressed electrical conduction. Furthermore, significant variation is noted with respect to serum potassium levels and clinical manifestation; in general, sudden or rapid increases in the potassium concentration in serum are associated with earlier development of clinical illness, including ECG abnormalities. It is important to note, however, that the relationship between potassium levels and ECG changes may vary between different patients. It is also important to realize that the ECG is not a reliable test for mild-to-moderate hyperkalemia.

Mild levels of hyperkalemia are associated with acceleration of terminal repolarization, resulting in T wave changes (Figure 58.2B and Table 58.1) – namely an increase in amplitude of the T wave. The T wave is described as prominent with descriptors such as “tenting” or “peaking”

both an herbal medicine and a drug of abuse. The majority of poisonings occur among youths attempting to use the plant for its hallucinogenic properties. Onset of effects typically begins within several hours of seed ingestion.

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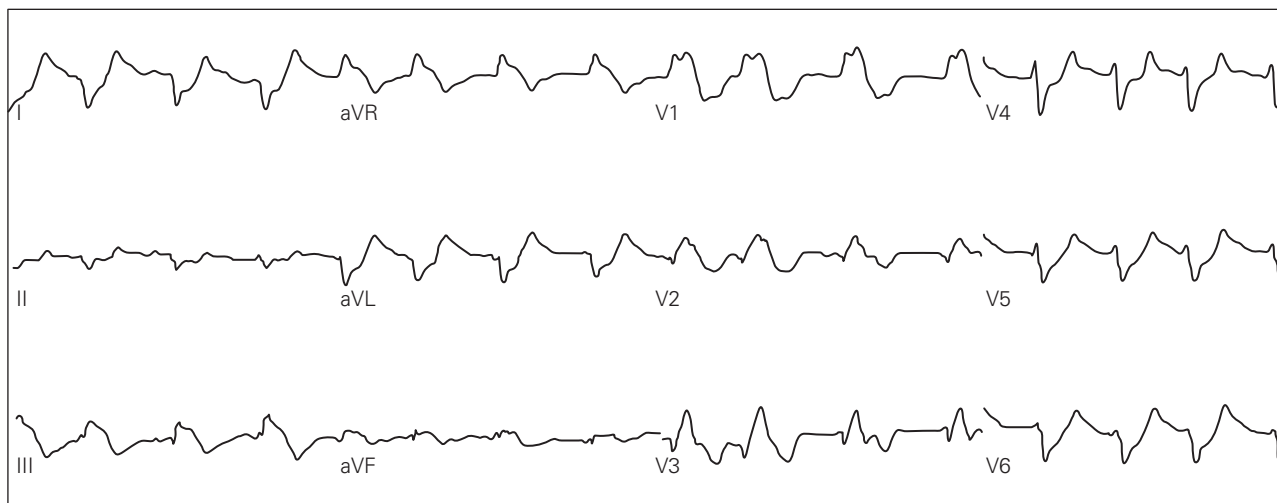


Figure 58.1 Wide QRS complex rhythm with a sine wave configuration.

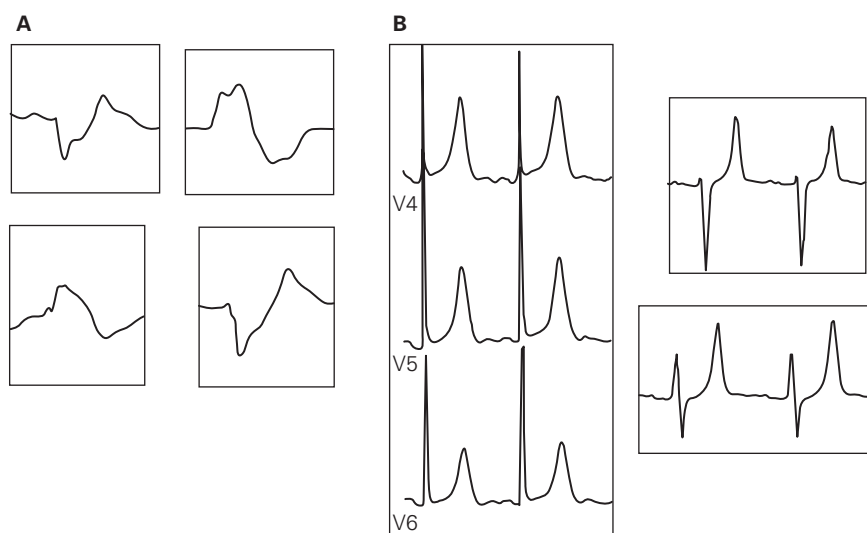


Figure 58.2 **A.** Wide QRS complex and wide sine wave configuration in pronounced hyperkalemia. **B.** Prominent T waves of hyperkalemia – tall, narrow, peaked, and symmetric.

of the T-wave; the T wave is tall, narrow, and symmetric. The “peaked” T wave is generally considered the earliest sign of hyperkalemia. Mild-to-moderate hyperkalemia causes depression of conduction, resulting in progressive prolongation of the PR and QRS intervals (Figures 58.1 and 58.2A; Table 58.1). The atrial myocardium is particularly sensitive to hyperkalemia. P wave amplitude lessens with progressive increase in the serum potassium; eventually, the P wave will disappear, even in the presence of continued sinus node activity, producing the “sinoven-tricular” rhythm of significant hyperkalemia. With minimal QRS complex widening, the ECG can mimic a bundle branch block appearance. As the QRS complex continues to widen and may eventually blend with the T wave, creating a “sine wave” appearance (Figures 58.1 and 58.2A). Continued increases in the potassium level eventually produce ventricular fibrillation.

The management of the patient with hyperkalemia includes therapies aimed at the stabilization of the myocardium (calcium), temporary shifting of the excess potassium intracellularly (dextrose, insulin, beta-adrenergic agonists, magnesium, and sodium bicarbonate), and ultimate removal of the potassium from the body (gastrointestinal binding resins and hemodialysis) – the goals of therapy are a reduction of the serum potassium level coupled with a stabilization of the myocardial cell membrane. Response to therapy is often prompt, with visualization noted on the ECG monitor; caution is advised, however, that improvement is often transient until definitive therapy (i.e., hemodialysis) has been provided. The most appropriate initial medication is calcium, delivered in the form of either calcium chloride or calcium gluconate. Calcium works by restoring a more appropriate electrical gradient across the cell membrane. Caution is

Table 58.1 Electrocardiographic manifestations of serum hyperkalemia relative to serum potassium level

Serum potassium	Electrocardiographic manifestations
5.5–6.5 mEq/L	Prominent T wave <ul style="list-style-type: none"> – Tall, narrow, symmetric – Most prominent in the precordial leads
6.5–8.0 mEq/L	Decreased P wave amplitude Prolonged PR interval Prominent T wave QRS complex widening (minimal to sine wave configuration) Dysrhythmia <ul style="list-style-type: none"> – Atrioventricular block – Intraventricular block – Bradycardia – Ventricular ectopy
>8.0 mEq/L	Sinoventricular rhythm <ul style="list-style-type: none"> – Absence of P wave – QRS complex widening, progressing to sine wave QRS complex Ventricular tachycardia Ventricular fibrillation Asystole

advised in the setting of hyperkalemia related to digoxin toxicity; anecdotal reports suggest a tendency towards asystole in this clinical setting. Several agents are capable of transiently moving the potassium from the extracellular to intracellular space, including glucose, insulin, beta-adrenergic agonists (i.e., albuterol), magnesium, sodium bicarbonate, and intravenous saline. Ultimate lowering of the serum potassium is accomplished with binding resins (e.g., sodium polystyrene) and/or hemodialysis.

Further reading

1. Amal Mattu A, Brady WJ, Robinson D. Electrocardiographic manifestations of hyperkalemia. *Am J Emerg Med* 2000; 18:721–9.
2. Schaefer TJ, Wolford RW. Disorders of potassium. *Emerg Med Clin North Am* 2005;23(3):723–47.

CASE 59 | Fishing in the Stomach

Answer: B

Diagnosis: Lead foreign body retained in the stomach

Discussion: Serious lead poisoning, including fatal events, has been associated with either massive lead foreign body ingestion or prolonged retention of foreign bodies in the gastrointestinal tract. There are reports of markedly elevated blood lead levels within 24 hours following the ingestion of large or multiple lead foreign bodies. Blood lead levels greater than 10 µg/dL are considered toxic by the Centers for Disease Control and Prevention, and gastrointestinal, hepatorenal, and neurotoxic effects have been reported with blood lead levels greater than 45 µg/dL. Prompt endoscopic removal should be performed when children present with lead foreign bodies retained within the stomach to avoid these complications. If blood lead levels are greater than 45 µg/dL the use of chelation therapy with succimer is recommended.

There are numerous myths and antiquated practices associated with gastrointestinal decontamination following toxin ingestion. Home use of syrup of ipecac has been abandoned, and it is inappropriate to administer in the emergency department. The use of gastric lavage is rarely indicated in the management of the poisoned patient.

Studies have failed to demonstrate a clinical benefit from the use of gastric lavage in the overdose setting. Gastric lavage was certainly not indicated in this case as the fishing weight was too large to remove by lavage. Whole bowel irrigation (WBI) involves the enteral administration of an osmotically balanced polyethylene glycol–electrolyte solution in a sufficient amount and rate to physically flush ingested substances through the gastrointestinal tract. It has been theorized, although not definitively proven, that toxins ingested may be purged with WBI before absorption can occur. WBI is not indicated in this case as the object ingested is too large to pass the pylorus (Figure 59.1).

Activated charcoal (AC) is still utilized in the emergency department for the decontamination of certain toxins from the gastrointestinal tract. AC is not indicated in this case as lead is not adsorbed by AC. If systemic absorption of an adsorbable toxin has already occurred, AC can adsorb and create a concentration gradient between the contents of the bowel and the circulation, thus enhancing elimination. AC also has the potential of interrupting enterohepatic circulation if the particular toxin is secreted in the bile and enters the gastrointestinal tract prior to reabsorption. Single-dose AC is indicated if

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Figure 59.1 The lead sinker seen in the previous case radiograph following endoscopic recovery.

the clinician estimates that a clinically significant fraction of the ingested substance remains in the gastrointestinal tract, the toxin is adsorbed by charcoal, and further absorption may result in clinical deterioration. AC is most effective within the first 60 minutes after oral overdose and decreases in effectiveness over time. AC is contraindicated in any patient with a compromised airway, after an ingestion of a corrosive substance (acid or alkali), and in cases where the toxin does not adsorb to AC.

Further reading

1. Betalli P, Rossi A, Bini M, Bacis G, et al. Update on management of caustic and foreign body ingestion in children. *Diagn Ther Endosc* 2009;969868.
2. St. Clair WS, Benjamin J. Lead intoxication from ingestion of fishing sinkers: a case study and review of the literature. *Clin Pediatr (Phila)* 2008;47(1):66–70.
3. Heard K. Gastrointestinal decontamination. *Med Clin North Am* 2005;89(6):1067–78.

CASE 60 | Overdose-induced Boiled Lobster Skin

Answer: D

Diagnosis: Boric acid toxicity

Discussion: This patient demonstrates the typical clinical manifestations of acute boric acid intoxication after a single large overdose. Boric acid is well absorbed through the gastrointestinal tract. Absorption can also occur across injured skin but not across intact skin. It is primarily eliminated unchanged by the kidney, with a reported elimination half-life ranging from 5 to 21 hours. The cellular mechanism of toxicity is unknown. Clinical toxicity has occurred following ingestion, parenteral administration, enemas, and application to the skin. Emesis of blue-green material is usually the first symptom and typically develops shortly after the ingestion. Central nervous system symptoms include lethargy, coma, and seizures. Dermatologic manifestations (Figures 60.1 and 60.2) include an erythematous desquamating full body rash (known as the “boiled lobster skin”) that mimics toxic epidermal necrolysis. The cutaneous changes may occur with any route of exposure and may be delayed for 3–5 days after the exposure.

Treatment of boric acid intoxication consists of providing supportive care. Gastric lavage may be indicated in massive ingestions if performed in the first hour after ingestion and if the patient has consumed a large amount



Figure 60.1 Spotty erythematous (“boiled lobster”) skin of the thigh commonly reported following boric acid ingestion.

of boric acid. Activated charcoal does not bind boric acid and is not indicated. Intravenous fluids may be required if the patient has vomiting and/or diarrhea. Local wound care is necessary if a desquamating dermatitis develops. Hemodialysis may enhance elimination in severe cases.



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Figure 60.2 Boric acid may induce bullous skin lesions and desquamation.

Further reading

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CASE 61 | Back Pain Following a Fall

Answer: B

Diagnosis: Lumbar (L2) wedge fracture

Discussion: Spinal fractures resulting from axial compression form a continuum from minor wedge compression and end plate fractures to severe burst fractures with spinal canal compromise. More than 150,000 persons in North America sustain fractures of the vertebral column each year, and 11,000 of these sustain spinal cord injuries. The thoracolumbar junction and lumbar spine are the most common sites for fractures due to the high mobility of the lumbar spine compared with the more rigid thoracic spine.

When the clinician encounters an axial compression injury to the spine, a determination must be made as to whether it is a simple (and stable) wedge fracture versus a more severe injury, such as a burst fracture with potential spinal instability. The most benign injuries, such as end plate fractures or wedge fractures involving a 50% or less loss of vertebral height, are relatively easy to manage. In these cases, the focus of patient management is adequate analgesia. Wedge fractures where there is more than 50% loss of height, multiple adjacent wedge fractures, significant kyphotic angulation, or any concern for posterior vertebral involvement or canal compromise are considered high risk and need further evaluation.

Radiographically, the clinician should look for findings on the lateral radiograph to help determine whether an injury represents a wedge fracture versus a burst fracture (Figure 61.1). Along with the 50% body height cut-off, the clinician also needs to look for posterior cortical disruption of the vertebral body, canal compromise, loss of pos-



Figure 61.1 Enlarged lateral lumbar spine film of the patient described. The L2 wedge fracture is plainly evident. There is loss of approximately 50% of the original vertebral height (compare the dashed lines with the solid lines). The posterior vertebral height is not affected.

terior vertebral height, or a compression angle of over 20 degrees, all of which are associated with more severe injuries.

A common question is “which patients need advanced imaging in the emergency department?” for clarification



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of these injuries. Axial imaging (as with computed tomography [CT]) is the gold standard for inspecting the posterior elements of the vertebra, as well as assuring the integrity of the bony spinal canal. Two studies (by Campbell in 1995 and Ballock in 1992) have tested whether clinicians can differentiate wedge versus burst morphology on plain film, using CT as a gold standard. In 17–20% of cases, burst fractures were misinterpreted on the plain films and thought to represent simple wedge injuries.

In summary, although the wedge fracture is not a spinal cord-threatening injury, the clinician must be sure that what appears to be a wedge fracture does not represent a burst injury, which has a markedly increased risk for instability and morbidity. In wedge fractures with 50% or greater loss of height, evidence of posterior cortical dis-

ruption, or a compression angle of over 20 degrees, it is wise to utilize CT to assess whether there is more extensive involvement.

Further reading

1. Bagley LJ. Imaging of spinal trauma. *Radiol Clin North Am* 2006;44:1–12.
2. Campbell SE, Phillips CD, Dubovsky E, et al. The value of CT in determining potential instability of simple wedge-compression fractures of the lumbar spine. *AJNR Am J Neuroradiol* 1995;16(7):1385–92.
3. Ballock RT, Mackersie R, Abitol JJ, et al. Can burst fractures be predicted from plain radiographs? *J Bone Joint Surg Br* 1992; 74(1):147–50.

CASE 62 | Painful Facial Rash

Answer: E

Diagnosis: Herpes zoster ophthalmicus

Discussion: Herpes zoster ophthalmicus is a reactivation of the varicella virus affecting the ophthalmic division of the trigeminal nerve. It is important to perform a careful medical history on patients presenting with herpes zoster ophthalmicus to determine whether the patient may be immunocompromised. Patients younger than 40 years require a complete systemic evaluation. Older patients do not require evaluation unless immunodeficiency is suspected from the case history.

Ocular manifestations of herpes zoster ophthalmicus are immense and often require long-term follow-up. When herpes zoster ophthalmicus affects the tip of the nose this is known as Hutchinson's sign, indicating involvement of the nasociliary branch of the ophthalmic division. There is a higher risk of ocular involvement in patients with a positive Hutchinson's sign. Ocular evaluation for patients with herpes zoster ophthalmicus includes visual acuity, intraocular pressures, careful slit-lamp examination, and a dilated fundus examination.

Patients who have had active skin lesions for less than 72 hours should be started on an oral antiviral agent such

as acyclovir, 800mg five times a day, or famciclovir, 500mg three times a day. Patients that are systemically ill or immunocompromised should be admitted to the hospital and given intravenous acyclovir. Bacitracin or erythromycin ointment should be applied to the skin lesions three times a day. Patients with ocular involvement need ophthalmologic consultation since they may require corticosteroid therapy and regular outpatient follow-up. A primary physician should also manage these patients since pain from herpes zoster ophthalmicus is often severe, and postherpetic neuralgia can linger for months.

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1. Liesegang TJ. Herpes zoster ophthalmicus natural history, risk factors, clinical prevention and morbidity. *Ophthalmology* 2008;115(2 Suppl):S3–12.
2. Pavan-Langston D. Herpes zoster antivirals and pain management. *Ophthalmology* 2008;115(2 Suppl):S13–20.
3. Baran R, Kechijian P. Hutchinson's sign: a reappraisal. *J Am Acad Dermatol* 1996;34(1):87–90.

CASE 63 | Intense Wrist Pain Following Trauma

Answer: C

Diagnosis: Perilunate dislocation

Discussion: Perilunate dislocation (Figure 63.1) usually occurs in the setting of a fall on outstretched hand

("FOOSH"). Diagnosis is suggested by history of a hyperextension injury with persistent pain, swelling, and deformity; however, patients may present innocuously complaining only of a "sprained wrist." The most common

of these injuries. Axial imaging (as with computed tomography [CT]) is the gold standard for inspecting the posterior elements of the vertebra, as well as assuring the integrity of the bony spinal canal. Two studies (by Campbell in 1995 and Ballock in 1992) have tested whether clinicians can differentiate wedge versus burst morphology on plain film, using CT as a gold standard. In 17–20% of cases, burst fractures were misinterpreted on the plain films and thought to represent simple wedge injuries.

In summary, although the wedge fracture is not a spinal cord-threatening injury, the clinician must be sure that what appears to be a wedge fracture does not represent a burst injury, which has a markedly increased risk for instability and morbidity. In wedge fractures with 50% or greater loss of height, evidence of posterior cortical dis-

ruption, or a compression angle of over 20 degrees, it is wise to utilize CT to assess whether there is more extensive involvement.

Further reading

1. Bagley LJ. Imaging of spinal trauma. *Radiol Clin North Am* 2006;44:1–12.
2. Campbell SE, Phillips CD, Dubovsky E, et al. The value of CT in determining potential instability of simple wedge-compression fractures of the lumbar spine. *AJNR Am J Neuroradiol* 1995;16(7):1385–92.
3. Ballock RT, Mackersie R, Abitol JJ, et al. Can burst fractures be predicted from plain radiographs? *J Bone Joint Surg Br* 1992; 74(1):147–50.

CASE 62 | Painful Facial Rash

Answer: E

Diagnosis: Herpes zoster ophthalmicus

Discussion: Herpes zoster ophthalmicus is a reactivation of the varicella virus affecting the ophthalmic division of the trigeminal nerve. It is important to perform a careful medical history on patients presenting with herpes zoster ophthalmicus to determine whether the patient may be immunocompromised. Patients younger than 40 years require a complete systemic evaluation. Older patients do not require evaluation unless immunodeficiency is suspected from the case history.

Ocular manifestations of herpes zoster ophthalmicus are immense and often require long-term follow-up. When herpes zoster ophthalmicus affects the tip of the nose this is known as Hutchinson's sign, indicating involvement of the nasociliary branch of the ophthalmic division. There is a higher risk of ocular involvement in patients with a positive Hutchinson's sign. Ocular evaluation for patients with herpes zoster ophthalmicus includes visual acuity, intraocular pressures, careful slit-lamp examination, and a dilated fundus examination.

Patients who have had active skin lesions for less than 72 hours should be started on an oral antiviral agent such

as acyclovir, 800mg five times a day, or famciclovir, 500mg three times a day. Patients that are systemically ill or immunocompromised should be admitted to the hospital and given intravenous acyclovir. Bacitracin or erythromycin ointment should be applied to the skin lesions three times a day. Patients with ocular involvement need ophthalmologic consultation since they may require corticosteroid therapy and regular outpatient follow-up. A primary physician should also manage these patients since pain from herpes zoster ophthalmicus is often severe, and postherpetic neuralgia can linger for months.

Further reading

1. Liesegang TJ. Herpes zoster ophthalmicus natural history, risk factors, clinical prevention and morbidity. *Ophthalmology* 2008;115(2 Suppl):S3–12.
2. Pavan-Langston D. Herpes zoster antivirals and pain management. *Ophthalmology* 2008;115(2 Suppl):S13–20.
3. Baran R, Kechijian P. Hutchinson's sign: a reappraisal. *J Am Acad Dermatol* 1996;34(1):87–90.

CASE 63 | Intense Wrist Pain Following Trauma

Answer: C

Diagnosis: Perilunate dislocation

Discussion: Perilunate dislocation (Figure 63.1) usually occurs in the setting of a fall on outstretched hand

("FOOSH"). Diagnosis is suggested by history of a hyperextension injury with persistent pain, swelling, and deformity; however, patients may present innocuously complaining only of a "sprained wrist." The most common

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In summary, although the wedge fracture is not a spinal cord-threatening injury, the clinician must be sure that what appears to be a wedge fracture does not represent a burst injury, which has a markedly increased risk for instability and morbidity. In wedge fractures with 50% or greater loss of height, evidence of posterior cortical dis-

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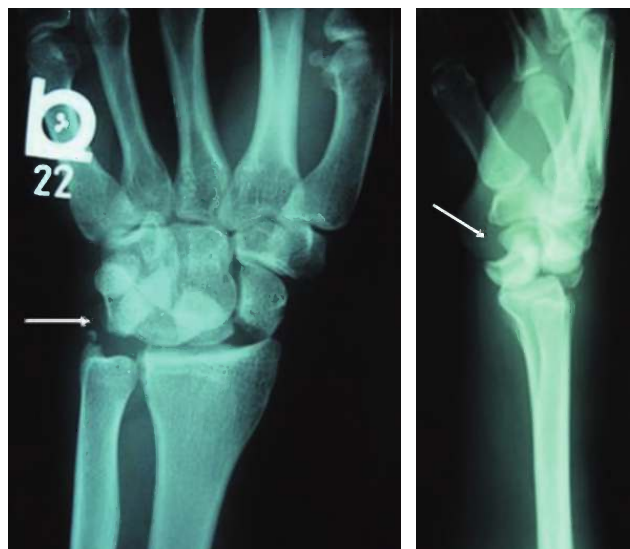


Figure 63.1 Perilunate dislocation (seen best on lateral view) with an ulnar styloid fracture (arrow on anteroposterior view).

clinical association is median nerve injury, but ulnar nerve injury, arterial injury, and tendon damage may also occur. Many clinicians believe that perilunate injuries are generally underdiagnosed due to their subtle nature, but it is estimated that they comprise less than 10% of all wrist injuries.

Perilunate injuries can be classified into four stages:

- **Stage I:** scapholunate dissociation. This is characterized by the “Terry-Thomas sign,” which is widening of the scapholunate joint on the posteroanterior radiograph

(named after a British comedian with a gap between his front teeth).

- **Stage II:** perilunate dislocation. The lunate remains in position relative to the distal radius, and the capitate is dorsally dislocated. This is best seen on the lateral radiograph.
- **Stage III:** perilunate dislocation with dislocation of the triquetrum. This is best seen on the posteroanterior radiograph, with overlap of the triquetrum on the lunate or hamate.
- **Stage IV:** lunate dislocation. The lunate rotates in a volar direction, resulting in a triangular appearance on the posteroanterior radiograph. On the lateral radiograph, the lunate will look like a cup tipped forward towards the palm, which is known as the “spilled teacup sign.”

Perilunate fractures and dislocations require open reduction and internal fixation as soon after the injury as possible. Closed reduction may be attempted in the emergency department until the definitive procedure can be performed.

Further reading

1. Soejima O, Iida H, Naito M. Transscaphoid–transtriquetral perilunate fracture dislocation: report of a case and review of the literature. *Arch Orthop Trauma Surg* 2003;123(6):305–7.
2. Perron AD, Brady WJ, Keats TE, Hersh RE. Orthopedic pitfalls in the ED: lunate and perilunate injuries. *Am J Emerg Med* 2001;19(2):157–62.

CASE 64 | Fever and Drooling in a Child

Answer: C

Diagnosis: Retropharyngeal abscess

Discussion: Retropharyngeal abscesses (RPAs) are primarily a disease of childhood, and most frequently occur in children between ages 2 and 4. These infections become less common after age 4 because the retropharyngeal lymph nodes that occupy the prevertebral space that drain the nasopharynx, middle ear, and posterior paranasal sinuses typically begin to involute by the age of 5. Clinical symptoms and signs of retropharyngeal abscesses include fever, irritability, neck stiffness and pain that worsens with extension, and drooling. In severe cases, respiratory distress and stridor may be present. On physical examination, one might see bulging of the posterior pharyngeal wall. However, because of the difficulty of the physical examination in this population, this may not be

visualized. The involved organisms are most commonly include Group A *Streptococcus*, *Staphylococcus aureus*, and oral anaerobes.

Radiographic and laboratory evaluation of children with high fever, an ill appearance, drooling, and/or neck stiffness is important to differentiate RPA from other conditions, including epiglottitis, foreign body aspiration, and meningitis. Lateral neck images are often obtained in an effort to evaluate the width of the prevertebral space and anterior displacement of the airway. To avoid artificially widened spaces, the child’s neck should be kept in full extension during inspiration. Pathology should be suspected if the retropharyngeal space is greater than 7 mm at C2 or 14 mm at C6.

Computed tomography (CT) scanning with contrast may be used to further characterize the nature of the

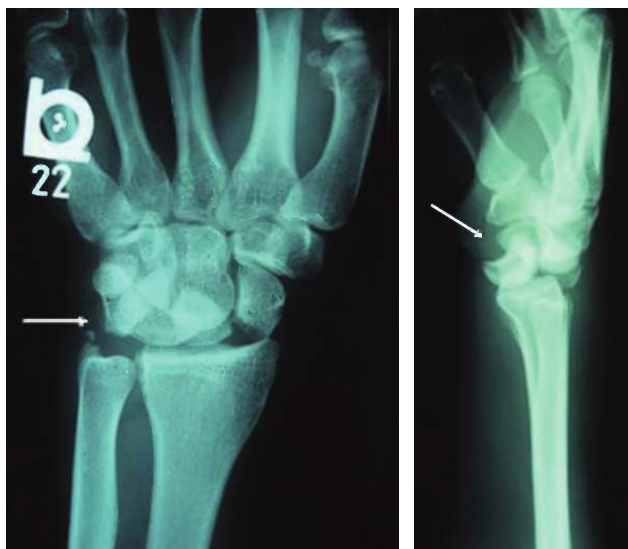


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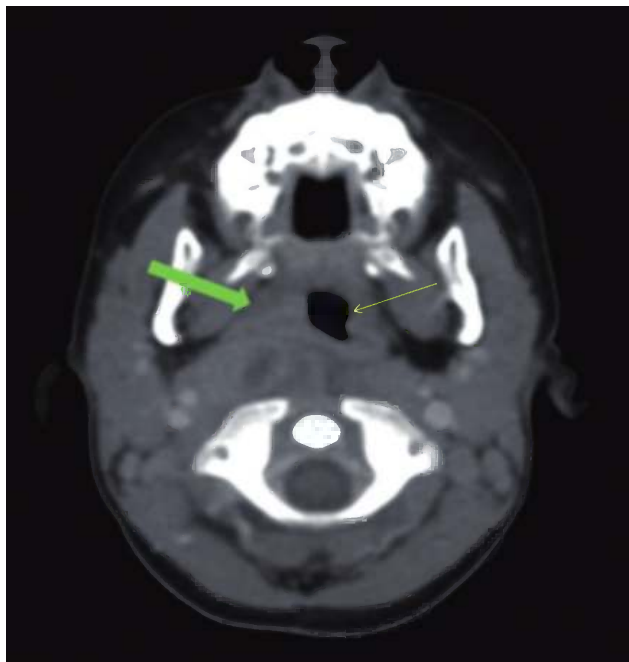


Figure 64.1 CT scan revealing a retropharyngeal abscess, with the green arrow pointing to the abscess and the yellow arrow pointing to the airway.

swelling and has become the gold standard for evaluating the difference between cellulitis and true abscess (Figure 64.1). Patients with obvious respiratory distress are the most likely candidates for early surgical drainage, and a

CT scan can help to guide the surgical approach. In more subtle cases, CT findings can be useful in determining whether or not surgical drainage is required as CT can help to determine the size of the abscess, extension of the infection into neighboring regions, and the extent of airway compromise. The management of RPA is appropriate antibiotic coverage with or without surgical drainage. While many of these collections have been historically drained, newer data suggest that only 25–50% of patients require surgery, and that in many cases surgery may be safely delayed by 24–48 hours while awaiting a response to intravenous antibiotics.

Further reading

1. Johnston D, Schmidt R, Barth P. Parapharyngeal and retropharyngeal infections in children: argument for a trial of medical therapy and intraoral drainage for medical treatment failures. *Int J Pediatr Otorhinolaryngol* 2009;73(5):761–5.
2. Al-Sabah B, Bin Salleen H, Hagr A, et al. Retropharyngeal abscess in children: 10-year study. *J Otolaryngol* 2004;33(6):352–5.
3. Craig FW, Schunk JE. Retropharyngeal abscess in children: clinical presentation, utility of imaging and current management. *Pediatrics* 2003;111(6):1394–8.

CASE 65 | Syncope and Flank Pain in an Elderly Man

Answer: C

Diagnosis: Abdominal aortic aneurysm leak

Discussion: Sonographic evaluation of the abdominal aorta requires real-time visualization of the aorta from the diaphragmatic hiatus to the bifurcation, as imaged from the xiphoid process to the umbilicus. About 90% of all aneurysms are found inferior to the renal arteries. Effective aortic scanning requires differentiation of several retroperitoneal structures in both the transverse and longitudinal plane. Beginning with a transverse approach in the subxiphoid space, identify a vertebral body, which is seen as a curvilinear hyperechoic structure resembling an inverted “U” casting a dense shadow. The aorta lies just anterior and to the left of the vertebral body. The aorta should not be confused with the inferior vena cava (IVC), which is further to the patient’s right, is thin walled, does not have any branches from its anterior surface, and collapses with deep inspiration and probe pressure. Of note, the IVC, like the aorta, *does* have pulsations.

Bowel gas and patient obesity may interfere with the complete visualization of the aorta, resulting in failure to identify a saccular or a localized fusiform abdominal aortic aneurysm (AAA). Maneuvers that may assist in obtaining acceptable images include applying firm pressure with the transducer to collapse air-filled loops of bowel, imaging from the right flank using the liver as an acoustic window, and placing the patient in the left lateral decubitus position. A limited sonographic study mandates alternative imaging. The sensitivity of bedside ultrasound for AAA when performed by appropriately trained emergency physicians approaches 100%.

The aortic diameter is measured from outer wall to outer wall in an anteroposterior direction, and can be obtained in either a transverse or a longitudinal plane, although a transverse approach may yield more accurate results. The normal aorta is less than 3 cm in diameter and tapers from the diaphragm to its bifurcation. Any dimension greater than this is technically an aneurysm, although

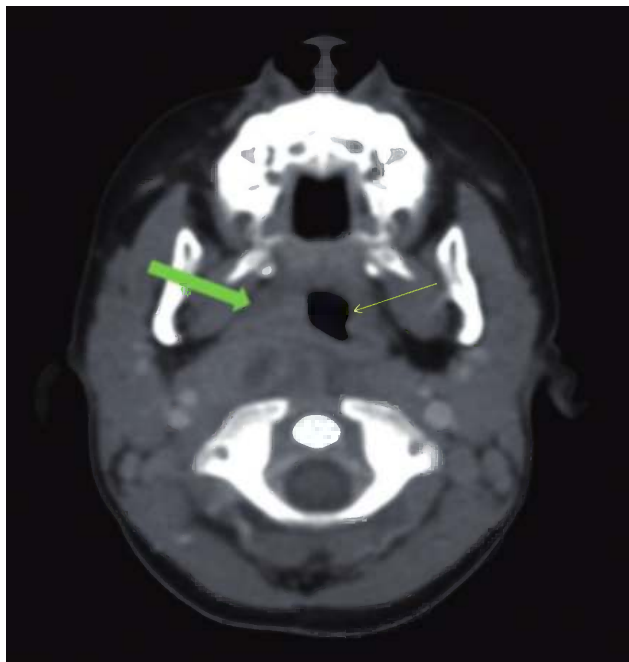


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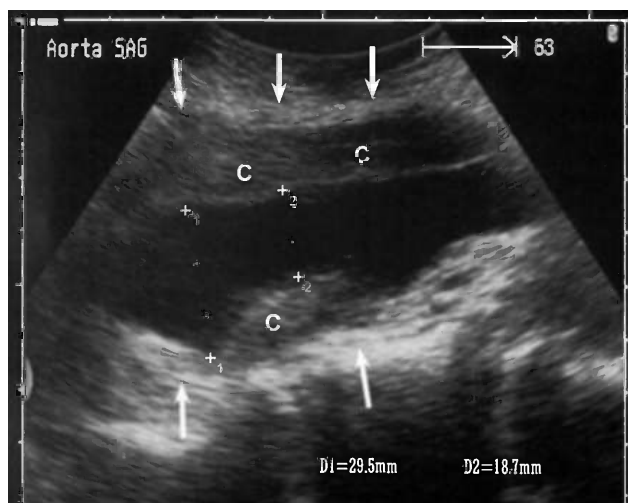


Figure 65.1 Sagittal view of the aorta from the case described here with arrows delineating the true extent of the aneurysm. C, clot.

problems rarely occur at diameters less than 4cm. The 5-year rupture rate for aneurysms less than and greater than 5cm is less than 4% and more than 25%, respectively. Many AAAs develop echogenic intraluminal thrombus, which can be mistaken for the true aortic walls, as in the present case. Figure 65.1 shows the image from this case with arrows delineating the true extent of the aneurysm. Figure 65.2 shows a lower transverse view than that shown in the case, with the aneurysm and the pseudolumen more readily apparent.

AAAs rupture into the peritoneal cavity only 10–20% of the time. Most of these patients die before reaching the emergency department. More commonly, symptoms are due to acute tears of the vessel wall with varying amounts of extravasation. Leaks that are nonlethal tend to occur in the left retroperitoneum. Based on this natural history, the syncope frequently seen in patients with acute AAA is most likely due to pain and an ensuing vasovagal response rather than massive hemorrhage. For this reason, it is more useful to speak of an “acute” or “symptomatic” rather than “ruptured” AAA. Any aneurysm causing acute symptoms should be treated with equal urgency,



Figure 65.2 A lower transverse view of the aorta than that view shown in the case, with the aneurysm and the pseudolumen more readily apparent. Ps, pseudolumen.

regardless of the patient’s current vital signs, hemodynamic status, or evidence of hemorrhage. Overall mortality for ruptured AAA is 50%. Early recognition, preparation for potentially rapid and fatal hemodynamic decompensation, emergent surgical consultation, and operative intervention are necessary for optimal management.

Further reading

1. Knaut AL, Kendall JL, Pattern R, Ray C. Ultrasonographic measurement of aortic diameter by emergency physicians approximates results obtained by computed tomography. *J Emerg Med* 2005; 28:119–26.
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Acknowledgement: We thank Daniel K. Vining, MD and Anthony J. Dean, MD for their contribution to this case in the previous edition.

CASE 66 | Get Them Undressed!

Answer: C

Diagnosis: Meningococcemia

Discussion: *Neisseria meningitidis* is an encapsulated Gram-negative aerobic diplococcus that is a strictly human pathogen. It most commonly causes meningitis although also may cause bacteremia, referred to meningococcemia.

The clinical presentation ranges from mild illness to fulminant disease, and at least 10% of infections result in death. The duration of symptoms can range from less than 12 hours to greater than 14 days. Petechiae or purpura with fever are the classical findings of meningococcemia. Other findings include headache, neck stiffness, hyperthermia,

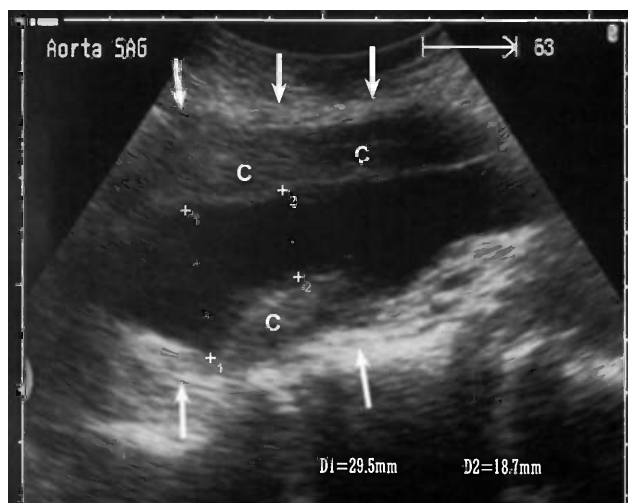


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hypothermia, hypotension, arthritis, seizures, irritability, lethargy, emesis, diarrhea, cough, and rhinorrhea.

The skin should be carefully examined for the presence of lesions, which may be the only clue to meningococemia. Petechiae are present in 50–60% of cases, but macular and maculopapular nodules are also common. Septic shock with petechiae or purpura indicates endotoxin release and/or disseminated intravascular coagulation. Other causes of petechiae can include thrombotic thrombocytopenic purpura, idiopathic thrombocytopenic purpura, blunt trauma, cirrhosis, nutritional deficiencies, chemotherapy, or thrombocytopenia of other origin.

Initial therapy includes placing the patient in isolation, administering immediate antibiotics, and drawing appropriate cultures. Transmission can occur via infected secretions so it is necessary to use droplet isolation precautions to protect staff, family, and other patients. Because meningococemia can have such a rapidly progressive course,

antibiotics should be administered as soon as possible. The patient in this case shows evidence of septic shock, further indicating that he should receive antibiotics without delay, including computed tomography of the head and lumbar puncture. Cultures, including blood and cerebrospinal fluid, should be drawn as soon as possible to help isolate the pathogenic organism.

Further reading

1. Brigham KS, Sandora TJ. *Neisseria meningitidis*: epidemiology, treatment and prevention in adolescents. *Curr Opin Pediatr* 2009;21:437–43.
2. Hazelzet JA. Diagnosing meningococemia as a cause of sepsis. *Pediatr Crit Care Med* 2005;6(3):S50–4.
3. Holstege CP. Petechiae and purpura associated with meningococemia. *Ann Emerg Med* 2005;45(5):560.

CASE 67 | A “Blue Hue” Following Endoscopy

Answer: D

Diagnosis: Methemoglobinemia

Discussion: Methemoglobinemia occurs when the iron atom within the hemoglobin molecule is oxidized from the ferrous (Fe^{2+}) to the ferric (Fe^{3+}) form. This results in an impaired oxygen and carbon dioxide-carrying capacity that can lead to a functional anemia and tissue hypoxia. It most commonly occurs as the result of exposure to oxidizing compounds or their metabolites (such as in this case, where the patient received benzocaine during endoscopy), but can also result from genetic, dietary, or idiopathic causes. Methemoglobin (MHB) renders the blood a chocolate color, which is pathognomonic at the bedside. Nonanemic healthy patients can tolerate MHB levels up to 15% without symptoms. Levels between 20% and 30% may result in anxiety, tachycardia, changes in mental status, and headache. MHB levels above 50% may cause coma, seizures, dysrhythmias, and death. However, reports of patients with levels greater than 70% have been reported with minimal symptoms.

The most important mechanism for prevention of methemoglobinemia in humans is the nicotinamide adenine dinucleotide (NADH) dependent methemoglobin reductase system (Figure 67.1). This enzyme is responsible for the removal of the majority of MHB that is produced in normal circumstances. The other enzyme, nicotinamide adenine dinucleotide phosphate (NADPH) methemoglobin reductase, is a minor pathway for the removal of MHB under normal conditions. However, when high concentrations of MHB are present, the NADH

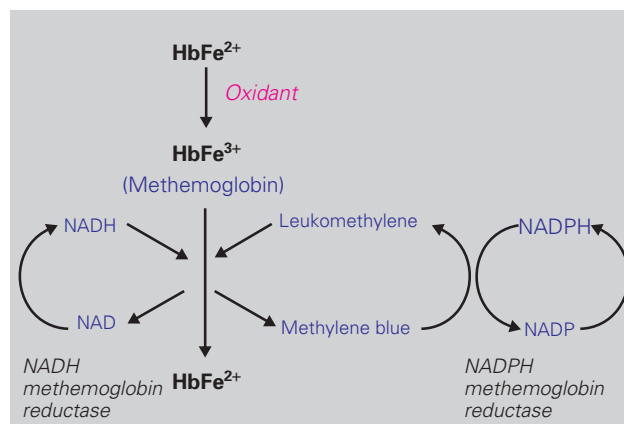


Figure 67.1 The enzymatic pathways to reduce methemoglobin.

enzyme pathway becomes saturated and the NADPH enzyme system becomes dominant.

Cyanosis occurs in patients when as little as 1.5 g/dL hemoglobin is in the MHB form, whereas 5 g/dL deoxyhemoglobin is required to produce cyanosis. Pulse oximetry is misleading when MHB is present. Pulse oximetry only measures the relative absorbance of two wavelengths of light, thereby only differentiating oxyhemoglobin from deoxyhemoglobin. At high levels of MHB, the pulse oximeter reads a saturation of approximately 85%, which corresponds to equal absorbance of both wavelengths. The partial pressure of oxygen on the arterial blood gas reflects plasma oxygen content and does not correspond to the oxygen-carrying capacity of hemoglobin. Therefore,

hypothermia, hypotension, arthritis, seizures, irritability, lethargy, emesis, diarrhea, cough, and rhinorrhea.

The skin should be carefully examined for the presence of lesions, which may be the only clue to meningococemia. Petechiae are present in 50–60% of cases, but macular and maculopapular nodules are also common. Septic shock with petechiae or purpura indicates endotoxin release and/or disseminated intravascular coagulation. Other causes of petechiae can include thrombotic thrombocytopenic purpura, idiopathic thrombocytopenic purpura, blunt trauma, cirrhosis, nutritional deficiencies, chemotherapy, or thrombocytopenia of other origin.

Initial therapy includes placing the patient in isolation, administering immediate antibiotics, and drawing appropriate cultures. Transmission can occur via infected secretions so it is necessary to use droplet isolation precautions to protect staff, family, and other patients. Because meningococemia can have such a rapidly progressive course,

antibiotics should be administered as soon as possible. The patient in this case shows evidence of septic shock, further indicating that he should receive antibiotics without delay, including computed tomography of the head and lumbar puncture. Cultures, including blood and cerebrospinal fluid, should be drawn as soon as possible to help isolate the pathogenic organism.

Further reading

1. Brigham KS, Sandora TJ. *Neisseria meningitidis*: epidemiology, treatment and prevention in adolescents. *Curr Opin Pediatr* 2009;21:437–43.
2. Hazelzet JA. Diagnosing meningococemia as a cause of sepsis. *Pediatr Crit Care Med* 2005;6(3):S50–4.
3. Holstege CP. Petechiae and purpura associated with meningococemia. *Ann Emerg Med* 2005;45(5):560.

CASE 67 | A “Blue Hue” Following Endoscopy

Answer: D

Diagnosis: Methemoglobinemia

Discussion: Methemoglobinemia occurs when the iron atom within the hemoglobin molecule is oxidized from the ferrous (Fe^{2+}) to the ferric (Fe^{3+}) form. This results in an impaired oxygen and carbon dioxide-carrying capacity that can lead to a functional anemia and tissue hypoxia. It most commonly occurs as the result of exposure to oxidizing compounds or their metabolites (such as in this case, where the patient received benzocaine during endoscopy), but can also result from genetic, dietary, or idiopathic causes. Methemoglobin (MHB) renders the blood a chocolate color, which is pathognomonic at the bedside. Nonanemic healthy patients can tolerate MHB levels up to 15% without symptoms. Levels between 20% and 30% may result in anxiety, tachycardia, changes in mental status, and headache. MHB levels above 50% may cause coma, seizures, dysrhythmias, and death. However, reports of patients with levels greater than 70% have been reported with minimal symptoms.

The most important mechanism for prevention of methemoglobinemia in humans is the nicotinamide adenine dinucleotide (NADH) dependent methemoglobin reductase system (Figure 67.1). This enzyme is responsible for the removal of the majority of MHB that is produced in normal circumstances. The other enzyme, nicotinamide adenine dinucleotide phosphate (NADPH) methemoglobin reductase, is a minor pathway for the removal of MHB under normal conditions. However, when high concentrations of MHB are present, the NADH

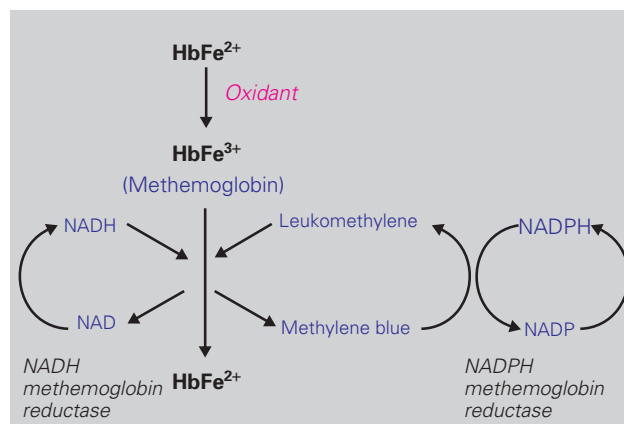


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in patients with MHB, their partial pressure of oxygen remains within the normal reference range. Co-oximetry should be requested to measure the MHb level. Co-oximetry can measure the relative absorbance of four different wavelengths of light and can thereby differentiate MHb from carboxyhemoglobin, oxyhemoglobin, and deoxyhemoglobin.

Once the diagnosis has been made, treatment is supportive for patients with minimal signs or symptoms. For symptomatic patients, methylene blue is the treatment of choice. Methylene blue is an oxidizing agent that is reduced to leukomethylene blue via the NADPH methemoglobin reductase enzyme. Leukomethylene blue then reduces methemoglobin to hemoglobin through conversion of iron from the ferric (Fe^{3+}) to the ferrous (Fe^{2+}) state.

Methylene blue is dosed at 1–2 mg/kg of a 1% solution, infused intravenously over 3–5 minutes. If there is no improvement in symptoms, this dose can be repeated at 30-minute intervals up to a maximum dose of 7 mg/kg. Methylene blue, when infused, can cause burning at the site of injection. The intravenous line should be flushed promptly after injection. Rapid administration or higher doses of methylene blue can result in thoracic pain,

dyspnea, hypertension, and diaphoresis. Doses above 15 mg/kg can cause direct damage to the erythrocyte and hemolysis with Heinz bodies. Dosing should be monitored carefully in patients with renal failure, as the kidneys excrete both methylene blue and leukomethylene blue. Methylene blue may also result in a false lowering of the pulse oximetry saturation readings.

Further reading

1. Ash-Bernal R, Wise R, Wright SM. Acquired methemoglobinemia: a retrospective series of 138 cases at 2 teaching hospitals. *Medicine (Baltimore)* 2004;83(5):265–73.
2. Henretig FM, Gribetz B, Kearney T, et al. Interpretation of color change in blood with varying degree of methemoglobinemia. *J Toxicol Clin Toxicol* 1988;26:293–301.
3. Wright RO, Lewander WJ, Woolf AD. Methemoglobinemia: etiology, pharmacology, and clinical management. *Ann Emerg Med* 1999;34(5):646–56.

Acknowledgement: We thank Andrew L. Homer for his contribution to this case in the previous edition.

CASE 68 | Acute-onset Blurred Vision

Answer: E

Diagnosis: Ocular foreign body

Discussion: Ocular foreign bodies are frequently encountered in emergency departments (Figure 68.1). The evaluation of patients presenting with possible ocular foreign bodies is dictated by a careful history. The mechanism of injury and suspected particulate matter is crucial in determining the presence and location of the foreign body. For instance, a history of metal striking metal should raise concern for a possible intraocular foreign body. Visual acuity must be documented prior to examin-

ing the eye or performing any procedure. Perform a careful pupillary evaluation with attention to the size and shape of each pupil as well as the response to stimulation. Thorough slit-lamp examination should be conducted for any irregularities or asymmetry in the conjunctiva, cornea, anterior chamber, iris, or lens. Provided there is no evidence of globe perforation, the eyelids must be everted when a foreign body is suspected under the lids (Figure 68.2). Dilated fundus examination is required for patients with suspected intraocular foreign body. An ultrasound or computed tomography (CT) scan of the orbits may be

Figure 68.1 The photos above show the corneal foreign body of the case presented before and after removal. The photo on the right reveals a residual rust ring and corneal infiltrate.



in patients with MHB, their partial pressure of oxygen remains within the normal reference range. Co-oximetry should be requested to measure the MHb level. Co-oximetry can measure the relative absorbance of four different wavelengths of light and can thereby differentiate MHb from carboxyhemoglobin, oxyhemoglobin, and deoxyhemoglobin.

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necessary when an intraocular or intraorbital foreign body is suspected.

Corneal foreign bodies are best evaluated with a slit lamp. Assessment of the foreign body depth should be determined prior to removal. Foreign bodies that have penetrated into the anterior chamber should be removed in the operating room. Most embedded foreign bodies can be removed at the slit lamp under topical anesthesia using a 25-g needle or foreign body spud. A red-brown rust ring results if a foreign body has been embedded for more than a few hours (see Figure 68.1). The rust ring is best removed using a battery-powered ophthalmic burr. Therapy following a foreign body removal includes a broad-spectrum antibiotic. Cycloplegia should be considered if an anterior chamber reaction is present. Re-examination in 24 hours is required.

Vertical linear scratches on the cornea often indicate a foreign body embedded in the palpebral conjunctiva



Figure 68.2 An everted eyelid with an insect stuck to the palpebral conjunctiva.

under the eyelid. The linear scratches result from the foreign body rubbing on the cornea as the patient blinks their eyes. Conjunctival foreign bodies can usually be removed with a moist cotton-tip applicator or simple irrigation. A broad-spectrum antibiotic ointment should be instilled after foreign body removal.

The diagnosis of a penetrating ocular injury is often obvious to the observer however; some may be quite subtle and require a high index of suspicion and careful observation (Figure 68.3). A detailed history and nature of the injury should be obtained. Visual acuity must be documented and a careful examination performed. Signs suggestive of intraocular foreign body include deep eyelid laceration, conjunctival laceration/hemorrhage, iris–corneal adhesion, a shallow anterior chamber, hypotony, an iris defect, and an acute cataract. A CT scan of the brain and orbits (1-mm axial and coronal views) should be obtained (Figure 68.4). Since over 90% of intraocular foreign bodies are metallic, magnetic resonance imaging is contraindicated in most cases of suspected intraocular foreign body. Patients suspected of having an intraocular foreign body require ophthalmologic consultation. The eye should be protected with a shield. Patients should be made nil by mouth and placed on bed rest with bathroom privileges. Tetanus prophylaxis should be given when indicated, and antiemetics prescribed to prevent Valsalva-induced vomiting.

The management of patients with an intraorbital foreign body in the emergency department involves shielding the eye and consulting the ophthalmology team. Tetanus toxoid should be given when indicated. Hospitalization is necessary for foreign bodies requiring surgical removal. Patients should be treated with a 10–14-day course of systemic antibiotics and should be monitored closely for evidence of infection.

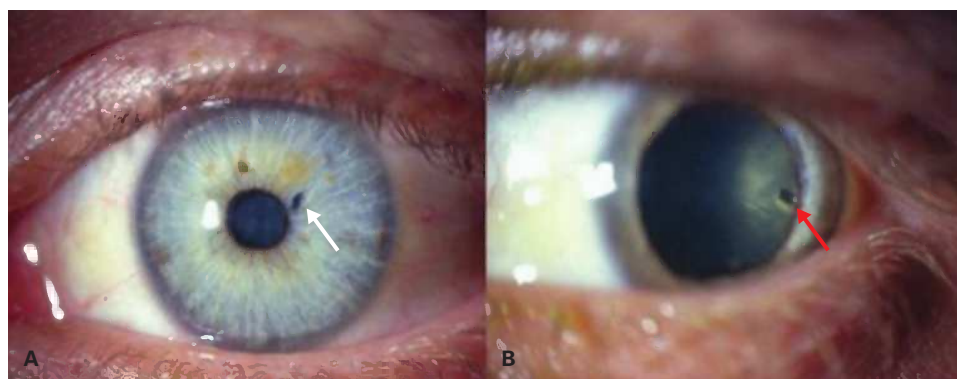


Figure 68.3 **A.** Photograph demonstrating a defect near the pupillary border (white arrow). **B.** Examination with the pupil dilated reveals a posterior subcapsular cataract with an intraocular foreign body imbedded in the posterior lens (red arrow).



Figure 68.4 This patient pictured above has suffered a perforating ocular injury with an entrance wound in the cornea and an exit wound somewhere in the posterior pole of the eye. The white substance in the anterior chamber is hydrated lens material that resulted from the foreign body passing through the lens and disrupting the lens capsule. A CT scan of the brain and orbits is indicated for all patients suspected of having an ocular or orbital foreign body. The CT scan in this case shows an intraorbital foreign body (red arrow) in the posterior orbit lodged between the lateral rectus muscle and the optic nerve. The patient also has a positive Seidel test. This is a simple test to determine if a full-thickness wound is present. It is performed using fluorescein and a cobalt blue light. Fluorescein is instilled into the eye, and the wound is observed using the blue light. A test is positive when aqueous leaks out of the wound and is seen washing away the fluorescein.

Further reading

1. Babineau MR, Sanchez LD. Ophthalmologic procedures in the emergency department. *Emerg Med Clin North Am* 2008;26:17–34.
2. Mester V, Kuhn F. Intraocular foreign bodies. *Ophthalmol Clin North Am* 2002;15:235–42.

CASE 69 | Elbow Pain in a Child After a Fall

Answer: E

Diagnosis: “Fat pad sign”

Discussion: The “sail sign” or the “fat pad sign,” depicted by the presence of anterior and posterior fat lucencies, is seen on this lateral radiograph of the elbow (Figure 69.1). This sign suggests the potential presence of a supracondylar fracture in children and a radial head or proximal ulnar fracture in adults. “Sail sign” refers to the triangular appearance of the anterior fat pad on imaging. The anterior fat pad may be seen in a normal radiograph along the anterior, distal humerus, but it becomes displaced superiorly and anteriorly in the presence of a hemarthrosis from a likely intra-articular fracture. In contrast, the posterior fat pad is not seen in normal radiographs because it lies within the olecranon fossa. If present, the posterior fat pad is best seen on a lateral view, with the elbow in 90 degrees of flexion. The presence of a posterior fat pad is always considered abnormal and a sign of significant distention of the joint capsule from a hemarthrosis. If the posterior fat pad is present in the setting of trauma, there is greater than 90% incidence of



Figure 69.1 Sail sign. The long arrow is pointing to the anterior sail sign; the short arrow is pointing to the posterior sail sign.

an intra-articular fracture. Most cases of a radiograph with a positive “fat pad sign” but no visible fractures have been found to have an abnormality on magnetic resonance imaging, suggesting that the “fat pad sign” is a



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an intra-articular fracture. Most cases of a radiograph with a positive “fat pad sign” but no visible fractures have been found to have an abnormality on magnetic resonance imaging, suggesting that the “fat pad sign” is a

good indicator for elbow trauma. In the absence of trauma, inflammatory etiologies must be considered, including septic joint, gout, and bursitis.

Another diagnostic technique used to detect less obvious supracondylar fractures is the “anterior humeral line,” which involves tracing a line along the anterior surface of the distal humerus through the capitellum. The capitellum should then be divided into three equal sections horizontally. The anterior humeral line should pass through the middle section of the capitellum. If this line transects the anterior rather than the middle section, or passes completely anterior to the capitellum, there is likely a supracondylar fracture or physis disruption of the capitellum.

The radiocapitellar line is helpful for determining a radial head dislocation or a radial neck fracture. This

involves drawing a line through the central portion of the radius. The axis of this line should intersect the capitellum. If the line does not intersect the capitellum, it is likely there is a dislocation of the radial head or a fracture of the radial neck.

Further reading

1. O'Dwyer H, O'Sullivan P, Fitzgerald D, et al. The fat pad sign following elbow trauma in adults: its usefulness and reliability in suspecting occult fracture. *J Comput Assist Tomogr* 2004;28(4):562–5.
2. Goswami G. The fat pad sign. *Radiology* 2002;222:419–20.

CASE 70 | Confusion, Anemia, and Abdominal Pain in a Toddler

Answer: D

Diagnosis: Lead encephalopathy due to ingestion of paint chips

Discussion: There are multiple radio-opacities noted in the plain film consistent with ingestion of paint chips (arrowed in Figure 70.1).

A list of the more common radio-opacities is summarized by the mnemonic CHIPES – calcium/chloral hydrate, heavy metals/halogenated hydrocarbons, iron, phenothiazines/potassium, enteric-coated, and salicylates. However, multiple studies regarding the radio-opacity of ingested pharmaceuticals have not consistently supported this and other mnemonics.

A United States federal mandate has banned the use of lead in house and furniture paint since 1978. Any child who lives in or has contact with a house built before this time is at risk for elevated lead levels through the ingestion of chips or by frequent hand-to-mouth activity in the dust-laden dilapidated environment. Children have a fairly efficient absorption of lead, averaging 40–50%. Lead affects multiple organ systems by disrupting various enzymatic activities. In children, subtle clinical effects may be seen even at low lead levels ($<10\mu\text{g/dL}$). Obvious acute neurotoxicity at much higher levels is attributable to cerebral edema from fluid egress across the blood–brain barrier. Lead disrupts many of the enzymes in heme biosynthesis, resulting in a microcytic hypochromic anemia that mimics iron deficiency anemia. Vomiting, anorexia, constipation, and “lead colic” have all been described in children.



Figure 70.1 Radiopacities (arrow) corresponding to pieces of old lead paint eaten by the child.

Lead encephalopathy, as demonstrated in this case, must be treated emergently with chelation therapy. Dimercaprol is the chelator of choice because it readily crosses the blood–brain barrier. Dimercaprol is the only chelator that is both renally cleared and biliary cleared. The disadvantages of dimercaprol include the following:

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(1) it is administered only by intramuscular injection; (2) injection is exceedingly painful, and the dimercaprol needs to be mixed with an anesthetic such as procaine; (3) it is mixed in peanut oil and cannot be given to children with known peanut allergies. CaNa_2EDTA , the only other parenteral chelator, does not cross the blood–brain barrier. Administration of CaNa_2EDTA solely without dimercaprol could place the patient at risk for progressive cerebral edema by mobilizing lead from the other tissues and causing it to redistribute into the brain.

Asymptomatic children should be chelated with oral succimer at levels only exceeding $44\mu\text{g/dL}$. Health

Department notification should be made at blood lead levels at or exceeding $10\mu\text{g/dL}$.

Further reading

1. Schwarz KA, Alsop JA. Pediatric ingestion of seven lead bullets successfully treated with outpatient whole bowel irrigation. *Clin Toxicol* 2008;46(9):919.
2. St. Clair WS, Benjamin J. Lead intoxication from ingestion of fishing sinkers: a case study and review of the literature. *Clin Pediatr* 2008;47(1):66–70.

CASE 71 | A Ground-level Fall with Ankle Pain

Answer: E

Diagnosis: Unstable trimalleolar fracture – urgent orthopedic consultation

Discussion: Ankle fractures and dislocations are among the most common orthopedic injuries cared for in the emergency department. The majority of ankle injuries involve a rotational mechanism. Patients typically report an immediate onset of pain following the traumatic event and are unable to bear weight.

The initial evaluation of a patient with an acute ankle injury begins with a directed history. The mechanism of the injury will focus the evaluation toward understood patterns of injury. Information regarding the patient's ability to ambulate following the event assists in the decision to obtain radiographs. Secondary injuries from the traumatic event and the cause of the event should be identified.

A directed physical examination is performed to identify areas of tenderness. The ankle joint includes the distal fibula, tibia, and talus. The bony structures of the ankle are easily palpable secondary to minimal soft tissue coverage. Careful examination of the medial ankle includes assessing for tenderness of the distal tibia and the deltoid ligament. Examination of the lateral ankle includes assessment of the distal fibula and the anterior talofibular, posterior talofibular, and calcaneofibular ligaments. The anterior ankle is palpated to assess for injury to the tibi-ofibular syndesmotom ligament, and the Achilles tendon is palpated in the posterior ankle. Neurovascular status should be examined to exclude secondary injury. Examination of the knee and foot is necessary to evaluate for secondary injuries associated with ankle injury (fractures of the proximal fibula and base of the fifth metatarsal in particular).

The decision to perform radiographs can be guided by the Ottawa Ankle Rules (OAR). Following the OARs, radiographs are obtained if there is an inability to bear weight immediately after the event or in the emergency department, or if there is tenderness at the tip or posterior aspect of the distal 6 cm of the medial or lateral malleolus. Anteroposterior and lateral radiographs will reveal the majority of ankle fractures. Additionally, the mortise view (anteroposterior view rotated 15 degrees internally) may be of assistance if suspicion for bony injury is high and standard views are equivocal.

Fractures of the ankle joint are classified either as stable or unstable. Stable fractures involve one side of the ankle joint, either the medial or lateral malleolus. If the fracture involves either malleolus with ligamentous disruption of the opposite side of the ankle, the fracture is identified as unstable. An example is a fracture of the lateral malleolus and disruption of the medial deltoid ligament. Unstable ankle fractures, which involve both sides of the ankle joint, can be further classified as a bimalleolar fracture (involvement of the medial and lateral malleoli) or a trimalleolar fracture (involvement of the posterior, medial, and lateral malleoli). A trimalleolar fracture is apparent in this case (Figures 71.1 and 71.2).

Treatment of an unstable ankle fracture involves open reduction and internal fixation. The articular cartilage of the ankle requires proper alignment as small deviations lead to a significant risk for post-traumatic arthritic changes. Precise alignment is best achieved operatively. The timing of surgery is dependent on multiple clinical factors including patient stability, secondary injuries, and comorbidities. Orthopedic consultation should be obtained after the identification of the fracture for operative planning.

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A directed physical examination is performed to identify areas of tenderness. The ankle joint includes the distal fibula, tibia, and talus. The bony structures of the ankle are easily palpable secondary to minimal soft tissue coverage. Careful examination of the medial ankle includes assessing for tenderness of the distal tibia and the deltoid ligament. Examination of the lateral ankle includes assessment of the distal fibula and the anterior talofibular, posterior talofibular, and calcaneofibular ligaments. The anterior ankle is palpated to assess for injury to the tibi-ofibular syndesmotic ligament, and the Achilles tendon is palpated in the posterior ankle. Neurovascular status should be examined to exclude secondary injury. Examination of the knee and foot is necessary to evaluate for secondary injuries associated with ankle injury (fractures of the proximal fibula and base of the fifth metatarsal in particular).

The decision to perform radiographs can be guided by the Ottawa Ankle Rules (OAR). Following the OARs, radiographs are obtained if there is an inability to bear weight immediately after the event or in the emergency department, or if there is tenderness at the tip or posterior aspect of the distal 6 cm of the medial or lateral malleolus. Anteroposterior and lateral radiographs will reveal the majority of ankle fractures. Additionally, the mortise view (anteroposterior view rotated 15 degrees internally) may be of assistance if suspicion for bony injury is high and standard views are equivocal.

Fractures of the ankle joint are classified either as stable or unstable. Stable fractures involve one side of the ankle joint, either the medial or lateral malleolus. If the fracture involves either malleolus with ligamentous disruption of the opposite side of the ankle, the fracture is identified as unstable. An example is a fracture of the lateral malleolus and disruption of the medial deltoid ligament. Unstable ankle fractures, which involve both sides of the ankle joint, can be further classified as a bimalleolar fracture (involvement of the medial and lateral malleoli) or a trimalleolar fracture (involvement of the posterior, medial, and lateral malleoli). A trimalleolar fracture is apparent in this case (Figures 71.1 and 71.2).

Treatment of an unstable ankle fracture involves open reduction and internal fixation. The articular cartilage of the ankle requires proper alignment as small deviations lead to a significant risk for post-traumatic arthritic changes. Precise alignment is best achieved operatively. The timing of surgery is dependent on multiple clinical factors including patient stability, secondary injuries, and comorbidities. Orthopedic consultation should be obtained after the identification of the fracture for operative planning.



Figure 71.1 Lateral ankle radiographic view demonstrating fracture of the posterior malleoli of the tibia (circled).



Figure 71.2 Anteroposterior ankle radiograph demonstrating a displaced fracture of the distal tibia at the level of the talar dome. An oblique fracture of the distal fibula is visualized. Both fractures are also apparent on the mortise view. The fractures are denoted by the encircled areas.

Further reading

1. Davidovitch RI, Walsh M, Spitzer A, Egol KA. Functional outcome after operatively treated ankle fractures in the elderly. *Foot Ankle Int* 2009;30(8):728–33.
2. Tornetta P 3rd, Ostrum RF, Trafton PG. Trimalleolar ankle fracture. *J Orthop Trauma* 2001;15(8):588–90.
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CASE 72 | Traumatic Eye Pain and Proptosis

Answer: E

Diagnosis: Acute retrobulbar hemorrhage

Discussion: Acute retrobulbar hemorrhage can cause severe permanent vision loss if not recognized and treated in the emergency department. Vision loss occurs as the hemorrhage fills the retrobulbar space and transmits pressure to the outside of the globe, causing a dramatic elevation in the intraocular pressure. The acute rise in pressure can compress the circulation from mechanical tamponade and restrict flow through the central retinal artery. Treatment to lower the intraocular pressure should be initiated immediately when vision is threatened.

Medical treatment for elevated intraocular pressure should be initiated with a topical beta-blocker (timolol or levobunolol 0.5%) and alpha-agonist (brimonidine 0.15%), one drop each every 30 minutes for two doses. In addition, a carbonic anhydrase inhibitor such as acetazola-

mide (two 250 mg tablets orally or 500 mg intravenously) should be given. Mannitol (20%, 1.0 g/kg intravenously) can also decrease intraocular pressure by reducing vitreous volume. Caution must be observed when giving mannitol to patients with congestive heart failure or renal failure.

Performing a lateral canthotomy and cantholysis immediately lowers the intraocular pressure by expanding the intraorbital volume. This is accomplished by first anesthetizing the skin using 2% lidocaine with epinephrine. Next, an incision is made at the lateral canthus, exposing the canthal tendons. The lower limb of the canthal tendon is then incised using sharp scissors, releasing the lower lid from its lateral attachment. Surgical repair of the canthotomy/cantholysis is performed several days later when the swelling has subsided. Ophthalmology consultation is required for follow-up.



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Further reading

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2. Perry M, Dancey A, Mireskandari K, et al. Emergency care in facial trauma – a maxillofacial and ophthalmic perspective. *Injury* 2005;36:875–96.
3. Larian B, Wong B, Crumley RL, et al. Facial trauma and ocular/orbital injury. *J Craniomaxillofac Trauma* 1999;5(4):15–24.

CASE 73 | Diffuse Ankle Pain Following a Fall

Answer: D

Diagnosis: Talar fracture

Discussion: The talus is the second most frequently fractured tarsal bone after the calcaneus, and fractures of this bone are generally divided into injuries of the anatomic head, neck, and body. These injuries comprise 3–5% of all foot fractures, but are likely underreported as injuries to the talar dome frequently go undiagnosed. Injuries to the medial and lateral processes of the talus are relatively minor, while fractures through the body, neck, head, or posterior process can carry significant morbidity. The driving force in searching out these injuries is the fact that, like the scaphoid in the hand, blood supply to the talus is tenuous, and unrecognized or inadequately treated fractures can result in avascular necrosis to the bone. Even when identified early and treated appropriately, talus fractures may result in arthritis, chronic pain, and nonunion.

The potential for missing these injuries in the emergency department is real, as osteochondral fractures of the talar dome, posterior process fractures, and lateral process fractures all may be difficult to detect radiographically, and clinically can be mistaken for an ankle sprain. Talar fractures can be seen at any age and are usually the result of motor vehicle collisions or falls from a height.

Plain radiographs of both the foot and ankle are used to diagnose talar fractures (Figure 73.1). The views obtained depend on the particular fracture. Fractures of the lateral process are especially difficult to identify as they may be nearly invisible on the anteroposterior ankle radiograph or lateral view of the foot. Mortise views of the ankle can help evaluate the body of the talus, as well as detect injury to the talar dome. Computed tomography scanning and magnetic resonance imaging can be used to detect radiographically occult fractures of the talus as well as to determine the amount of articular surface involvement. While not required in the emergency department evaluation, the clinician should have a low threshold to obtain an advanced imaging study if there is concern for occult injury or a need to determine the full extent of the fracture.

The treatment for suspected or confirmed talar fractures depends on the fracture morphology and the portion



Figure 73.1 The medial talar fracture is indicated with an arrow.

of the bone involved. Nonarticular chip fractures can be treated conservatively with nonweight-bearing, splinting, and sure orthopedic outpatient follow-up. Significant fractures that require orthopedic consultation in the emergency department include those through the neck (due to blood supply issues) or those with significant articular surface involvement. If there is any doubt about the diagnosis or extent of injury, advanced imaging with CT or MRI is recommended.

Further reading

1. Stone JW. Osteochondral lesions of the talar dome. *Am J Orthop* 2007;36(12):643–6.
2. Ahmad J, Raikin SM. Current concepts review: talar fractures. *Foot Ankle Int* 2006;27(6):475–82.
3. LeBlanc KE. Ankle problems masquerading as sprains. *Prim Care* 2004;31(4):1055–67.

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CASE 74 | Rash Following Brush Fire

Answer: B

Diagnosis: Poison ivy dermatitis

Discussion: Poison ivy is a plant contained within the genus *Toxicodendron*. This genus includes species such as poison ivy (*T. radicans*), poison oak (*T. pubescens*), and poison sumac (*T. vernix*). The *Toxicodendron* species contain a substance called urushiol. In susceptible individuals, urushiol triggers a type IV delayed hypersensitivity reaction. The most common reaction seen involves the skin following direct contact with the plant (Figure 74.1) and is often described as presenting in linear streaks. However, if a susceptible person is exposed to smoke from burning plants, not only is a skin reaction seen (Figure 74.2), but also the eyes, airway, and lungs may be involved, with a potential for acute lung injury. Lesions generally appear

within 12–48 hours, although they may appear earlier. New lesions may continue to appear for up to a month. Initially, these lesions tend to occur from the slow reaction to adsorbed urushiol; however, lesions that appear later are often secondary to contact with contaminated surfaces (e.g., contaminated clothing or pet hair). The fluid from the vesicles of a rash does not contain urushiol and is not an irritant source for new lesions.

Urushiol penetrates the skin and binds within 15 minutes of contact. If the toxin can be removed before this occurs, the reaction can be avoided. Copious water irrigation should be performed if contact has occurred. Contaminated clothes should be washed. Topical preparations for symptomatic relief include Domeboro, calamine, and oatmeal baths. Oral antihistamines (i.e. hydroxyzine) are of benefit for the relief of pruritus. Oral systemic steroids are the standard for severe *Toxicodendron*-associated dermatitis. Prednisone or methylprednisolone can be administered and should be tapered over no less than 10–14 days. Early withdrawal of steroid therapy can lead to a return of the rash. Oral analgesics occasionally are required in the worst cases.



Figure 74.1 Poison ivy.



Figure 74.2 Classic *Toxicodendron* dermatitis of the arm following direct skin contact with the plant.

Further reading

1. Gladman AC. *Toxicodendron* dermatitis: poison ivy, oak, and sumac. *Wilderness Environ Med* 2006;17(2):120–8.
2. Guin JD. Treatment of *Toxicodendron* dermatitis (poison ivy and poison oak). *Skin Therapy Lett* 2001;6(7):3–5.

3. Park SD, Lee SW, Chun JH, Cha SH. Clinical features of 31 patients with systemic contact dermatitis due to the ingestion of *Rhus* (lacquer). *Br J Dermatol* 2000;142(5):937–42.

CASE 75 | Abdominal Pain in a Trauma Victim

Answer: C

Diagnosis: Splenic rupture

Discussion: The spleen is the most commonly injured intraperitoneal organ from blunt abdominal trauma. Motor vehicle collisions are the most common mechanism of injury (50–75%) in the United States, followed by direct blows to the abdomen (15%) and falls (6–9%). The majority of alert patients will have abdominal pain or left shoulder pain (Kehr’s sign) and left upper quadrant tenderness on examination. Others may exhibit signs of acute intraperitoneal hemorrhage, such as hypotension or tachycardia. Left-sided lower rib fractures are associated with 20% of splenic injuries.

Advances in diagnostic imaging have revolutionized the management of splenic injuries. In hemodynamically stable patients, abdominal and pelvic computed tomography imaging with intravenous contrast can reliably identify solid organ and retroperitoneal injury. By accurately defining the degree of splenic disruption, more patients may be eligible for nonoperative management. Using oral contrast rarely increases diagnostic accuracy and can delay imaging. Although the focused assessment for sonography in trauma (FAST) examination can be used to rapidly detect intraperitoneal blood, it cannot reliably identify solid organ injury without hemoperitoneum.

Operative management is dependent on the extent of the injury (Table 75.1) and the presence of hemodynamic instability. The role of angioembolization by interventional radiology in treating splenic injury remains controversial. There are some data to suggest that splenic angioembolization may increase the salvage rate in stable patients. Approximately 95% of children and 80% of adults are treated nonoperatively, with a successful splenic salvage rate of 95%. Nonoperative management of splenic injury in discharged patients should include bed rest for 72 hours, limiting physical activity for up to 6 weeks, and avoiding full contact sports for at least 8 weeks.

Delayed splenic rupture, characterized by abdominal pain and/or signs of internal bleeding that develop after an asymptomatic period of at least 48 hours, occurs in 1% of cases of blunt abdominal trauma. About 50% of patients will present within 1 week of their injury, usually precipitated by minor stress such as twisting or bending.

Table 75.1 American Association for the Surgery of Trauma Splenic Injury Scale

Grade	Type	Injury	Treatment
I	Hematoma Laceration	Subcapsular, <10% surface SA Capsular tear, <1 cm parenchymal depth	NO
II	Hematoma Laceration	Subcapsular, 10–50% SA; intraparenchymal, <5 cm diameter 1–3 cm parenchymal depth	NO
III	Hematoma Laceration	Subcapsular, >50% SA; intraparenchymal, >5 cm or expanding >3 cm parenchymal depth or involving trabecular vessels	NO/O
IV	Laceration Vascular	Laceration of segmental or hilar vessels Hilar vascular injury that devascularizes >25% of the spleen	O
V	Laceration Vascular	Completely shattered spleen Hilar vascular injury that devascularizes the spleen	O

NO, nonoperative; O, operative; SA, surface area.

Although uncommon, delayed diagnosis or misdiagnosis may cause significant morbidity and mortality.

Further reading

1. Peitzman AB, Ferrada P, Puyana JC. Nonoperative management of blunt abdominal trauma: have we gone too far? *Surg Infect* 2009;10:427–33.
2. Wei B, Hemmila MR, Arbabi S, et al. Angioembolization reduces operative intervention for blunt splenic injury. *J Trauma* 2008;64:1472–7.
3. Schroepel TJ, Croce MA. Diagnosis and management of blunt abdominal solid organ injury. *Curr Opin Crit Care* 2007;13:399–404.

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CASE 76 | Skin Target Lesion

Answer: B

Diagnosis: Erythema migrans from Lyme disease

Discussion: This is an example of the target lesion erythema migrans, associated with Lyme disease. Lyme disease is the most common vector-borne disease in the United States. It is caused by *Borrelia burgdorferi*, a spirochete, transmitted by the *Ixodes* species of deer tick. Lyme disease occurs in areas where there is an abundance of deer ticks and the percentage of infected ticks is high. The highest incidence of Lyme disease in the United States is found in north-eastern, north-central, and western states.

The transmission risk is directly related to the duration of tick feeding. Nymphs (responsible for 85% of transmission) require 36–48 hours of a blood meal for transmission, whereas adults require 48–72 hours. This would require that the tick be attached and engorged if found on the skin. Overall, the risk for Lyme disease after a tick bite in endemic areas has been shown to be only approximately 3%. These ticks not only carry Lyme disease, but also can carry *Babesia microti* and *Ehrlichia equi*.

The inoculation of *B. burgdorferi* into the skin leads to a local inflammatory reaction leading to the characteristic target lesion, erythema migrans. This is the only pathognomonic feature of Lyme disease, and it is sufficient to diagnose the disease. It typically appears as a flat erythematous lesion with reinforced borders, which expands with a constant diameter over a period of days. It can appear solid, ring-shaped with a central clearing or as a bull's eye. It appears at the site of attachment of the tick while the spirochetes are confined to the skin. Occasionally, vesicles and/or necrotic areas may occur at the center of the lesion, leading to pain in the usually asymptomatic lesion.

The appearance of erythema migrans usually signifies the “early localized” phase of disease, within the first 3–30 days after the tick bite, which may also be accompanied by regional lymphadenopathy and constitutional flu-like symptoms. Erythema migrans will resolve on its own, even without treatment, over several weeks, and the vast majority of cases go unnoticed. In the emergency department, it is important to differentiate erythema migrans from other conditions such as cellulitis, num-

mular eczema, granuloma annulare, ring worm, or an insect bite.

If the host's immune system does not contain the spirochete locally, hematogenous spread can lead to “early disseminated” disease. This stage may also present with erythema migrans, which may include single or multiple lesions. Additional symptoms include constitutional symptoms, meningitis, carditis, cranial neuritis, and radiculoneuritis. This phase is seen 3–12 weeks after the tick bite. Finally, “late disease” is seen greater than 2 months after the tick bite and is usually characterized as arthritis and/or central nervous system involvement. Lyme arthritis is the most common manifestation of Lyme disease that presents to the emergency department. It is usually mono- or oligoarticular (≤ 4 joints) and commonly presents with intermittent swelling of the knee, ankle, and/or elbow joints.

The treatment of choice for patients with early localized disease above 8 years of age is doxycycline. Children 8 years of age or younger should be treated with amoxicillin (50 mg/kg per day) to avoid the potential side effect of staining the enamel of pre-erupted teeth. For patients with Lyme disease with any associated central nervous system or cardiac involvement, intravenous therapy with ceftriaxone is recommended. If adequately treated, therapeutic failure is rare.

Prevention is as important as treatment in controlling this disease. A daily skin check in endemic areas is one of the best methods of prevention of spread of the disease. Immediate tick removal should be performed with care.

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1. Kowalski TJ, Tata S, Berth W, et al. Antibiotic treatment duration and long-term outcomes of patients with early Lyme disease from a Lyme disease-hyperendemic area. *Clin Infect Dis* 2010;50(4):512–20.
2. DePietropaolo DL, Powers JH, Gil JM, Foy AJ. Diagnosis of Lyme disease. *Am Fam Physician* 2005;72(2):297–304.
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CASE 77 | Chest Pain and a Confounding Electrocardiogram Pattern

Answer: B

Diagnosis: Left bundle branch block and acute myocardial infarction

Discussion: The ECG in this case demonstrates a normal sinus rhythm and a left bundle branch block (LBBB) with excessive discordant ST segment elevation in leads V2, V3, and V4 as well as concordant ST segment elevation in leads V5 and V6 – the findings are consistent with anterolateral ST elevation myocardial infarction (STEMI) in a LBBB pattern.

Patients with LBBB and acute myocardial infarction (AMI) are at an increased risk of experiencing a poor outcome; these patients should be rapidly and aggressively

managed. In patients with AMI, both the pre-existing and the new-onset LBBB are clinical markers for a significantly worsened prognosis in terms of higher mortality, lower left ventricular ejection fraction, and increased incidence of cardiovascular complications. The new development of LBBB in the setting of AMI suggests proximal occlusion of the left anterior descending artery; a prior history of LBBB in patients with acute myocardial infarction places the patient at risk for cardiogenic shock due to the often associated depressed left ventricular function. Despite this increased risk of poor outcome, patients with LBBB less often receive fibrinolytic therapy. These same patients show significant benefit when treated

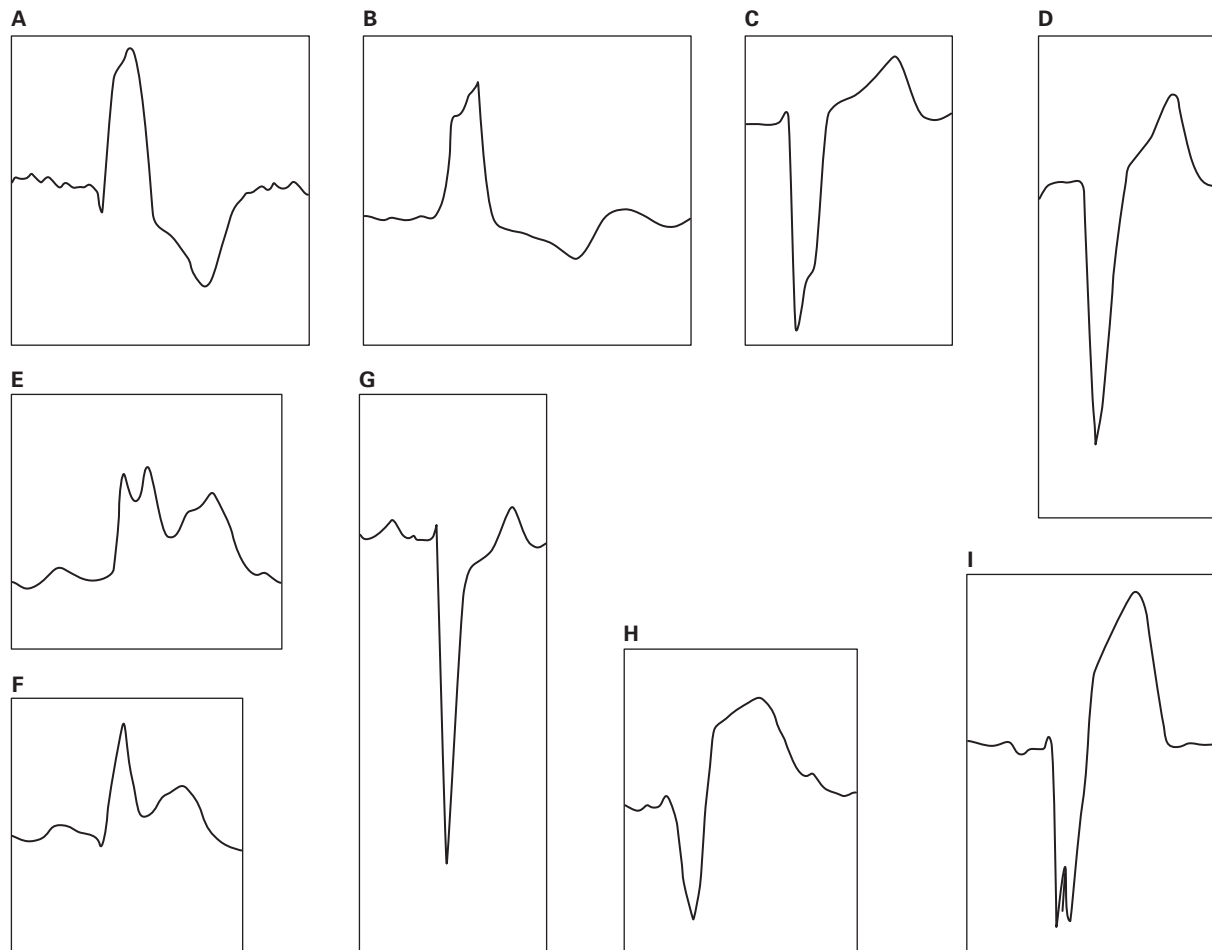


Figure 77.1 Rule of appropriate discordance in the LBBB pattern. **A.** Discordant ST segment depression (normal finding). **B.** Discordant ST segment depression (normal finding). **C.** Discordant ST segment elevation less than 5 mm (normal finding). **D.** Discordant ST segment elevation less than 5 mm (normal finding). **E.** Concordant ST segment elevation (abnormal finding, consistent with AMI). **F.** Concordant ST segment elevation (abnormal finding, consistent with AMI). **G.** Concordant ST segment depression (abnormal finding, consistent with AMI). **H.** Excessive, discordant ST segment elevation greater than 5 mm (abnormal finding, consistent with ACS). **I.** Excessive, discordant ST segment elevation greater than 5 mm (abnormal finding, consistent with ACS).

with thrombolytic therapy; the presence of a new LBBB in the setting of AMI is considered an indication for pharmacologic thrombolysis.

LBBB is a confounding pattern that reduces the ECG's ability to detect acute coronary syndrome (ACS). A new, or *presumably new*, LBBB is strongly suggestive of ACS when noted in the appropriate clinical presentation. Pre-existing LBBB, however, shares many ECG similarities with various ECG findings of ACS. In the normal LBBB presentation, the right-sided precordial leads demonstrate ST segment elevation and tall, upright T waves; these T waves mimic those prominent T waves seen in STEMI. The QS pattern of LBBB in these leads resembles the Q waves seen in infarction. Depressed ST segments with T wave inversions are seen in some or all of the lateral leads (V5, V6, I, and aVL) in LBBB; both of these resemble the ischemic changes seen in ACS. Yet these findings in LBBB are merely expressions of the "rule of appropriate discordance" (Figure 77.1).

The "rule of appropriate discordance" describes the appropriate ST segment deflections relative to the major portion of the QRS complex. The ST segment and T waves vectors are expectedly discordant, or opposite in direction, to the major vector of the QRS complex in those

leads. Sgarbossa and colleagues reported three electrocardiographic predictors of AMI in the presence of LBBB: (1) ST segment elevation of at least 1 mm that is concordant with the QRS complex; (2) ST segment depression of at least 1 mm in leads V1, V2, or V3; and (3) ST segment elevation of at least 5 mm that is discordant with the QRS complex. Ultimately, the approach to the patient with LBBB and possible myocardial infarction remains complicated; diagnostic adjuncts to the history and physical examination (e.g., serial ECGs, comparison with prior ECGs, echocardiography, serum cardiac marker measurement, etc.) should be liberally employed when the ECG does not show obvious evidence of AMI as noted by the Sgarbossa criteria.

Further reading

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2. Rosner MH, Brady WJ. The ECG diagnosis of acute myocardial infarction in the presence of left bundle branch block. *Am J Emerg Med* 1998;16(7):697–700.

CASE 78 | Sudden Sedation in a Student

Answer: E

Diagnosis: Opioid toxicity

Discussion: The first picture depicts the disconjugate gaze and miosis of heroin intoxication. The second picture depicts axillary injection sites. Opium, a dried extract from the poppy plant *Papaver somniferum*, has been used for medicinal purposes for centuries. Since ancient times, many opiate alkaloids such as morphine have been derived from the poppy plant. In addition, synthetic or semi-synthetic opioid agents have been derived by altering the chemical structure of morphine. All opioids act by binding to and stimulating opioid receptors.

The classic opioid toxidrome includes central nervous system depression, respiratory depression, and miosis. Other opioid toxic effects include hypotension, flushing, pruritus, bronchospasm, pulmonary edema, nausea, vomiting, and reduced gastrointestinal tract motility.

The diagnosis of opioid poisoning is clinical. Miosis is often an excellent clue but may be absent with certain drugs, such as propoxyphene, meperidine, and concurrent co-ingestions. A classic example of this is Lomotil, which contains an opiate agent (diphenoxylate) and atropine, which will cause mydriasis. Routine urine drug

screening is not required. Urine drug screening may yield false-negative results, especially in the case of synthetic opioids like methadone and propoxyphene.

Most deaths related to opioid poisoning are due to respiratory depression and hypoxia. A decrease in tidal volume as well as respiratory rate may be observed in opioid ingestion. Also, there are specific opioid agents that may cause other potentially lethal effects. Propoxyphene may cause cardiac dysrhythmias through effects on myocardial sodium channels. Seizures have been observed with propoxyphene and tramadol ingestions.

Management of patients with opioid poisoning involves maintenance of airway patency and supportive care. A chest radiograph may be helpful if there is a suspicion of aspiration or noncardiogenic pulmonary edema. Naloxone, an opioid receptor antagonist, may be administered to improve respiratory drive and ventilation. It is usually prudent to avoid complete reversal of the opioid drug effect to prevent acute withdrawal symptoms in opioid-dependent patients. Naloxone can be administered intravenously or intramuscularly or subcutaneously and should be carefully titrated to clinical effect.

with thrombolytic therapy; the presence of a new LBBB in the setting of AMI is considered an indication for pharmacologic thrombolysis.

LBBB is a confounding pattern that reduces the ECG's ability to detect acute coronary syndrome (ACS). A new, or *presumably new*, LBBB is strongly suggestive of ACS when noted in the appropriate clinical presentation. Pre-existing LBBB, however, shares many ECG similarities with various ECG findings of ACS. In the normal LBBB presentation, the right-sided precordial leads demonstrate ST segment elevation and tall, upright T waves; these T waves mimic those prominent T waves seen in STEMI. The QS pattern of LBBB in these leads resembles the Q waves seen in infarction. Depressed ST segments with T wave inversions are seen in some or all of the lateral leads (V5, V6, I, and aVL) in LBBB; both of these resemble the ischemic changes seen in ACS. Yet these findings in LBBB are merely expressions of the "rule of appropriate discordance" (Figure 77.1).

The "rule of appropriate discordance" describes the appropriate ST segment deflections relative to the major portion of the QRS complex. The ST segment and T waves vectors are expectedly discordant, or opposite in direction, to the major vector of the QRS complex in those

leads. Sgarbossa and colleagues reported three electrocardiographic predictors of AMI in the presence of LBBB: (1) ST segment elevation of at least 1 mm that is concordant with the QRS complex; (2) ST segment depression of at least 1 mm in leads V1, V2, or V3; and (3) ST segment elevation of at least 5 mm that is discordant with the QRS complex. Ultimately, the approach to the patient with LBBB and possible myocardial infarction remains complicated; diagnostic adjuncts to the history and physical examination (e.g., serial ECGs, comparison with prior ECGs, echocardiography, serum cardiac marker measurement, etc.) should be liberally employed when the ECG does not show obvious evidence of AMI as noted by the Sgarbossa criteria.

Further reading

1. Sgarbossa EB, Pinski SL, Barbagelata A, et al. Electrocardiographic diagnosis of evolving acute myocardial infarction in the presence of left bundle branch block. *N Engl J Med* 1996;334:481–7.
2. Rosner MH, Brady WJ. The ECG diagnosis of acute myocardial infarction in the presence of left bundle branch block. *Am J Emerg Med* 1998;16(7):697–700.

CASE 78 | Sudden Sedation in a Student

Answer: E

Diagnosis: Opioid toxicity

Discussion: The first picture depicts the disconjugate gaze and miosis of heroin intoxication. The second picture depicts axillary injection sites. Opium, a dried extract from the poppy plant *Papaver somniferum*, has been used for medicinal purposes for centuries. Since ancient times, many opiate alkaloids such as morphine have been derived from the poppy plant. In addition, synthetic or semi-synthetic opioid agents have been derived by altering the chemical structure of morphine. All opioids act by binding to and stimulating opioid receptors.

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Patients should be observed for re-sedation for 4–6 hours after the last dose of naloxone is given since the half-life of naloxone is shorter than that of most opioid agents. This observation period should be extended in those patients with renal insufficiency.

Acknowledgement: We thank Tracy Reilly, MD for her contribution to this case in the previous edition.

Further reading

1. Aquina CT, Marques-Baptista A, Bridgeman P, Merlin MA. OxyContin abuse and overdose. *Postgrad Med* 2009; 121(2):163–7.
2. Sporer KA. Acute heroin overdose. *Ann Intern Med* 1999; 130(7):584–90.

CASE 79 | Skin Lesions in a Comatose Patient

Answer: C

Diagnosis: Rhabdomyolysis

Discussion: Rhabdomyolysis is defined as the breakdown of skeletal muscle due to injury. Muscle injury can occur from multiple causes. This muscle damage may result in potential life-threatening complications including myoglobinuric acute renal failure, hyperkalemia, disseminated intravascular coagulation, and compartment syndrome.

The primary laboratory test that indicates the presence of rhabdomyolysis is an elevated serum creatine phosphokinase (CPK). The CPK-MM isoenzyme predominates in rhabdomyolysis, comprising at least 98% of the total value. The other laboratory indicator frequently seen in rhabdomyolysis is myoglobinuria. Myoglobin functions as an oxygen store in skeletal muscle fibers. As myoglobin is released into the circulation from damaged muscle cells, it produces visible pigmenturia (classically a “Coca-Cola” colored urine) that can be misidentified as hematuria. If a patient has what appears to be marked hematuria, but the microscopic examination of the urine fails to demonstrate any red blood cells, myoglobinuria should be suspected. Other important laboratory findings in rhabdomyolysis include hyperkalemia, hypocalcemia, hyperphosphatemia, hyperuricemia, and elevated levels of other muscle enzymes including lactate dehydrogenase and aminotransferases.

There is an extensive list of causes of rhabdomyolysis. Rare hereditary causes of rhabdomyolysis consist primarily of various metabolic enzyme defects and should be suspected in very young pediatric patients presenting without the usual precipitants or with recurrent rhabdomyolysis. There are numerous acquired causes, including traumatic, exertional, ischemic, metabolic, infectious, inflammatory, and toxic causes. Toxicologic causes of note include sympathomimetics and statin drugs. Although the causes of rhabdomyolysis are diverse, the pathogenesis follows a final common pathway, ultimately leading to muscle necrosis and the release of muscle components into the circulation. The common pathogenesis of all disease processes causing rhabdomyolysis is an acute rise

in the cytosolic and mitochondrial calcium concentration in affected muscle cells, which sets off a chain of calcium-induced intracellular enzyme activation and energy utilization that ultimately results in muscle cell necrosis. Irrespective of cause, rhabdomyolysis can have an 8% mortality rate.

The clinical features of rhabdomyolysis are variable depending on the cause of the rhabdomyolysis and can be vague or absent in 50% of patients. Muscle pain and weakness may be the presenting complaints in those patients who are alert. Muscle tenderness may be noted on examination. Patients who are comatose may have only subtle findings on examination. The case presented here demonstrates a patient whose only physical finding was skin breakdown over the pressure points noted in the illustrations (the patient was found lying on his side). As an additional example, Figure 79.1 demonstrates a patient comatose after overdosing on phenobarbital who had subtle skin changes in the area of her buttocks associated with pressure necrosis and underlying rhabdomyolysis.

The complications of rhabdomyolysis are due to the local effects of muscle injury and the systemic effects of released muscle components. Hyperkalemia can precipi-



Figure 79.1 Subtle skin changes associated with pressure necrosis in the buttock region of a patient comatose after a phenobarbital overdose. The patient was subsequently found to have marked underlying rhabdomyolysis. This case demonstrates the importance of exposing and completely examining the skin of all comatose patients presenting to the emergency department.

Patients should be observed for re-sedation for 4–6 hours after the last dose of naloxone is given since the half-life of naloxone is shorter than that of most opioid agents. This observation period should be extended in those patients with renal insufficiency.

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tate dysrhythmias and cardiac arrest. Hyperkalemia may be potentiated by associated hypocalcaemia resulting from calcium deposition in necrotic muscle tissue and calcium phosphate precipitation. Hyperkalemia should be recognized early and treated with appropriate pharmacologic therapies (e.g., intravenous fluids, albuterol, sodium bicarbonate, insulin with glucose, calcium, and ion exchange resins) and potentially emergent dialysis.

Compartment syndrome can develop in acute rhabdomyolysis as muscle swelling occurs within a tight fascial compartment, leading to compression of vessels and nerves. Prolonged ischemia and infarction of muscle tissue can result in replacement of muscle by inelastic fibrous tissue and severe contractures (e.g., Volkmann's contracture). The treatment of suspected compartment syndrome is urgent decompression by open fasciotomy.

Acute renal failure is the most common complication of rhabdomyolysis, occurring in approximately 30% of patients. Prevention of acute renal failure involves main-

tenance of circulating blood volume by adequate fluid replacement to assure a urine output of approximately 1.0 cm³/kg per hour. This can require up to 10 L of fluid per day. Mannitol may be considered to maintain diuresis in patients that are not anuric. Alkalinization of the urine by administering an intravenous infusion of sodium bicarbonate has been suggested since acidic urine favors myoglobin nephrotoxicity and cast formation. However, this therapy is controversial since there is no strong evidence that it alters clinical outcomes, and it can in fact induce further hypocalcemia.

Further reading

1. Bosch X, Poch E, Grau JM. Rhabdomyolysis and acute kidney injury. *N Engl J Med* 2009;361(1):62–72.
2. Bagley WH, Yang H, Shah KH. Rhabdomyolysis. *Intern Emerg Med* 2007;2:210–18.

CASE 80 | Raccoon Eyes

Answer: D

Diagnosis: Bilateral periorbital hematoma

Discussion: “Raccoon eyes,” depicted in the above picture, are also known as bilateral periorbital hematoma or ecchymosis, and are often a sign of basilar skull fracture. They are thought to occur as a result of blood tracking from the fracture along tissue planes into the periorbital tissue. This injury is associated with a high morbidity and mortality and should be diagnosed in a timely fashion. Basilar skull fractures are linear fractures at the base of the skull and often occur through the temporal bone, resulting in bleeding into the middle ear and hemotympanum. These fractures are also often associated with dural tears, and patients may be at risk for developing meningitis. Patients with basilar fractures may complain of vertigo, tinnitus, dizziness, and decreased hearing. In addition to periorbital hematoma, other signs of basilar skull fracture include mastoid ecchymosis (Battle's sign or retroauricular hematoma), hemotympanum, cerebral spinal fluid rhinorrhea or otorrhea, and seventh nerve palsy. Periorbital and mastoid ecchymoses may take a few hours to appear and may be absent during the initial evaluation.

A study examining the positive predictive values of the above clinical signs found unilateral periorbital hematoma to have a positive predictive value for skull base fractures of 90%, bilateral periorbital hematoma of 70%, and Battle's sign of 100%. The positive predictive values for acute intracranial lesions (including subdural hematoma, brain

contusion, pneumocephalus, epidural hematoma, and brain swelling) were 85% for unilateral periorbital hematoma, 68% for bilateral periorbital hematoma, and 66% for Battle's sign. This suggests that the clinical signs of raccoon eyes and Battle's sign have very high positive predictive values for both skull fractures and intracranial injury. Those patients who are suspected of having a skull fracture should undergo emergent computed tomography of the head to evaluate for intracranial injury and to define the fracture. Skull radiographs do not detect basilar skull fractures well. Patients with a basilar fracture should be admitted for observation. Antibiotics may be considered for the prevention of meningitis.

While raccoon eyes are most commonly seen with head trauma and skull base fractures, they have also been reported in association with severe thoracic trauma, multiple myeloma, amyloidosis, Kaposi's sarcoma, metastatic neuroblastoma, and cervical vertebral artery lacerations.

Further reading

1. Herbella FA, Mudo M, Delmonti C, et al. ‘Raccoon eyes’ (periorbital haematoma) as a sign of skull base fracture. *Injury* 2001;32(10):745–47.
2. Pretto Flores L, De Almeida CS, Casulari LA. Positive predictive values of selected clinical signs associated with skull base fractures. *J Neurosurg Sci* 2000;44(2):77–82.

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CASE 81 | Fall on an Outstretched Hand in a Young Adolescent

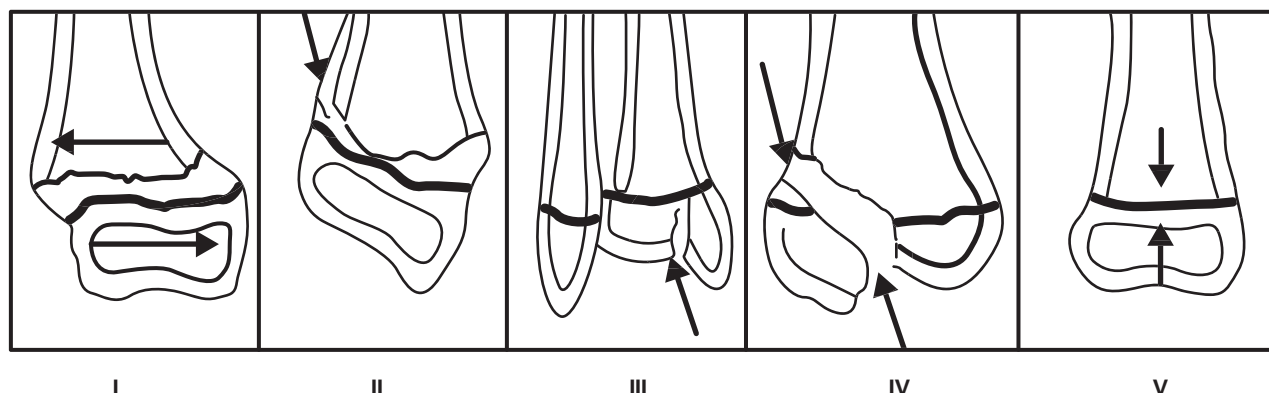


Figure 81.1 Salter-Harris injury classification system with types I to V. Note that increasing Salter-Harris classification system number carries a greater risk of growth arrest due to physeal injury.

Answer: B

Diagnosis: Distal radius fracture, Salter-Harris type I

Discussion: Musculoskeletal injuries are a common cause for pediatric emergency department visits. The long bones of the developing child contain a physeal or growth plate, also known as a physis. These cartilaginous centers give rise to the growth of new bone but also are an inherent weak point in the developing skeleton. The blood supply for this zone of bone growth comes from the epiphysis (the distal portion of the bone) and is essential for normal bone growth. In skeletally immature children, the ligamentous structures are both stronger and more flexible than the developing bone, making the physis more likely to incur a disruptive injury. The Salter-Harris classification system is most commonly used to describe these injuries. Graded from I to V, based on the involvement of the physis, epiphysis, and metaphysis, higher grades are associated with a greater prevalence of injury to the vascular supply and associated growth abnormalities.

The classic patterns described by Salter and Harris are depicted in Figure 81.1. Type I fractures (5%) are seen most frequently in infants and toddlers and involve a *slipped* epiphysis that separates from the metaphysis as the disruptive force travels through the physis (Figure 81.2). Salter-Harris type II injuries are the most common type encountered (75%) and are similar to type I injuries with an extension of the fracture line into the metaphysis. Salter-Harris type III injuries (10%) are intra-articular fractures of the epiphysis with extension of the fracture line through the physis. Salter-Harris type IV injuries (10%) involve a fracture that originates at the articular surface and crosses through the epiphysis, the growth plate, and exits through the metaphysis. Type IV injuries

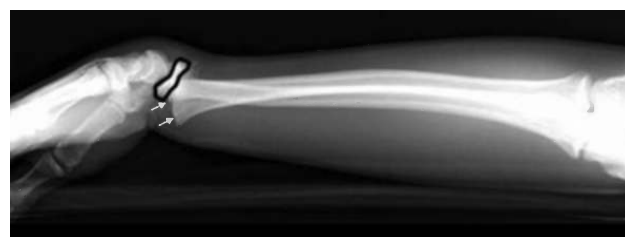


Figure 81.2 Lateral forearm and wrist with a Salter-Harris type I fracture of the distal radius. Note that the epiphysis (outlined in black) of the distal radius has been displaced into a dorsal position relative to the physis (arrowed) and metaphysis of the bone. The clinician can confuse the epiphysis in this radiograph with a carpal bone, entirely missing the growth plate fracture.

are seen most commonly at the distal humerus. Salter-Harris type V injuries are the least frequent of physeal fractures (1%) but are by far the most likely to result in focal bone growth arrest. These injuries occur most frequently at the knee or ankle and result from a compressive force across the physis (crushed growth plate).

A Salter-Harris type I injury is most appropriately managed with splint immobilization, intermittent icing, elevation, and referral to an orthopedic surgeon. Type II injuries, if there is no angulation or significant displacement of the fracture fragment, can be similarly managed. Type III and IV fractures usually require orthopedic consultation with near-perfect realignment of the epiphyseal fracture fragment to ensure adequate blood supply and joint congruity. Type V injuries similarly require orthopedic consultation with casting followed by limited use of the involved extremity.

Further reading

1. Leary JT, Handling M, Talerico M, et al. Physeal fractures of the distal tibia: predictive factors of premature physeal closure and growth arrest. *J Pediatr Orthop* 2009;29(4):356–61.
2. Lalonde KA, Letts M. Traumatic growth arrest of the distal tibia: a clinical and radiographic review. *Can J Surg* 2005;48(2):143–7.
3. Della-Giustina K, Della-Giustina DA. Emergency department evaluation and treatment of pediatric orthopedic injuries. *Emerg Med Clin North Am* 1999;17:895–922.

CASE 82 | Eye Pain and Facial Swelling

Answer: A

Diagnosis: Periorbital cellulitis

Discussion: Periorbital cellulitis, also called preseptal cellulitis, is a superficial skin infection that has not penetrated the orbital septum. Its presentation mimics the more serious orbital cellulitis, also called postseptal cellulitis, which is an infection of the deeper tissues of the orbit. In the majority of cases, the distinction can be made clinically without the need for radiographic studies. In cases where the clinical diagnosis is in question, an enhanced computed tomography (CT) scan of the orbits can aid in making a definitive diagnosis.

Periorbital cellulitis in adults and children over 5 years of age is usually the result of a secondary skin infection with *Staphylococcus aureus* as the predominant pathogen. In children aged 5 and under, *S. aureus* is still the most common pathogen, but *Haemophilus influenzae* is responsible for a significant minority, usually from bacteremic spread. Periorbital cellulitis in those 5 years and older can be treated with oral antibiotics and followed up in the outpatient department. Children under 5 are more likely to have a bacteremic source and should be treated with intravenous antibiotics to cover *S. aureus* and *H. influenzae*, have a blood culture drawn, and be considered candidates for hospital admission.

Orbital cellulitis is a more serious diagnosis. Figure 82.1 demonstrates a child with orbital cellulitis. This photograph demonstrates proptosis, edema, and limited ocular motility in the right eye as the child looks up to the left.

The majority of cases of orbital cellulitis result as an extension from an adjacent bacterial sinusitis. Orbital cellulitis in adults is usually a polymicrobial infection, whereas in children it is often caused by a single organism. The differential diagnosis of orbital cellulitis includes preceptal cellulitis, orbital pseudotumor, thyroid eye disease, orbital tumors, metastatic disease, varix, and trauma.

The CT scan in Figure 82.2 demonstrates a subperiosteal abscess (red arrow) overlying a nearly opacified sinus. CT scanning is essential in cases of suspected orbital cellulitis to confirm the diagnosis, to evaluate the sinuses, and to rule out orbital foreign body. Mucormycosis



Figure 82.1 Orbital cellulitis.



Figure 82.2 CT scan of orbital cellulitis.

is a life-threatening disease that must be considered in diabetic and immunocompromised patients presenting with orbital cellulitis.

Treatment for orbital cellulitis includes admission to the hospital for intravenous antibiotics. Blood cultures

should be obtained. The ear–nose–throat department should be consulted for surgical drainage if this is clinically indicated. Patients must be observed closely for optic nerve dysfunction by monitoring visual acuity and pupillary responses.

Periorbital and orbital cellulitis can usually be distinguished on clinical grounds. Periorbital cellulitis presentations typically lack fever and have normal eye examinations, including a full range of all extraocular eye movements, normal pupillary reflexes, and normal visual

acuity. In equivocal cases, CT of the orbits can help make the diagnosis.

Further reading

1. Bilyk JR. Periocular infection. *Curr Opin Ophthalmol* 2007;18(5):414–23.
2. Givner LB. Periorbital versus orbital cellulitis. *Pediatr Infect Dis J* 2002;21(12):1157–8.

CASE 83 | Wrist Pain Following Fall on an Outstretched Hand

Answer: C

Diagnosis: Scaphoid fracture

Discussion: Proper diagnosis of a wrist injury relies on a thorough knowledge of the relevant topographic anatomy combined with a careful physical examination and an appropriate radiographic assessment of an injured extremity. While “wrist sprain” is a common diagnosis, it often reflects inattention to these essential components and to the subtle findings that can reflect significant injury in the acute setting. Therefore, to minimize patient morbidity, wrist sprain should remain a diagnosis of exclusion.

Fractures of the scaphoid account for 60–70% of all diagnosed carpal injuries. Unfortunately, fracture of the scaphoid bone is a frequently missed diagnosis. Radiographic findings are either subtle or absent, making the diagnosis difficult. Accurate early diagnosis is critical as the morbidity associated with a missed or late diagnosis is significant and includes the potential for chronic pain, arthritis, malunion, osteonecrosis, and reduced function.

The classic history for a scaphoid fracture is the fall on the outstretched hand – the so-called FOOSH mechanism. A patient generally has immediate pain with varying degrees of soft tissue swelling and loss of range of motion. It is not uncommon for a patient to continue his or her activity, seeking medical care later and in the interim sustaining further damage to the bone. Along with pain on axial loading of the thumb, point tenderness within the carpus is the most important diagnostic test in assessing injuries to the wrist, making it essential that clinicians be comfortable with the anatomy of this area.

The anatomic snuffbox is located between the first and third dorsal compartments of the wrist. It is best visualized by bringing the thumb into radial abduction and noting the hollow situated between the tendons of exten-

sor pollicis longus, abductor pollicis longus, and extensor pollicis brevis. The radial styloid is palpable at the base of the snuffbox, and the body of the scaphoid is palpable in the depths of this hollow. Eliciting pain with palpation of the scaphoid bone in the anatomic snuffbox is the most reliable diagnostic maneuver.

The scaphoid tuberosity can be palpated on the palmar aspect of the wrist. It is the bony prominence at the base of the thenar muscles at the intersection of the flexor carpi radialis and the radial aspect of the distal wrist crease. Direct palpation of the scaphoid tuberosity should also demonstrate tenderness in the patient with a scaphoid fracture. An additional maneuver involves placing an axial load on the thumb in extension; with a fracture of the scaphoid, force is transmitted to the injured bone, producing pain.

Although a proper history and thorough physical examination can suggest a scaphoid fracture, in the majority of cases it is only confirmed by radiographic evaluation. A typical wrist series includes the anteroposterior, lateral, and oblique views. Supplemental views, such as the navicular view (a focused image of the scaphoid oriented in an anteroposterior fashion with the long axis of the bone parallel to the film), provide additional radiographic assistance. However, even with appropriate films and interpretation, these fractures can be difficult to see (Figures 83.1–83.3). A significant percentage of these fractures will not be visible on any view at initial presentation. Since a number of these fractures are not radiographically apparent on initial evaluation, suspected injuries (i.e., snuffbox tenderness or pain with axial loading) should be treated as though a fracture exists. Immobilization with a thumb spica splint and referral to a clinician in 10–14 days for re-evaluation are appropriate. Strict adherence to this policy will ensure that even an occult fracture will be appropriately treated without



Figure 83.1 An anteroposterior radiographic view of the wrist demonstrates a normal-appearing scaphoid bone (black oval circle) with normal relationships to adjacent carpal structures.



Figure 83.2 A navicular view of the patient in Figure 1 demonstrates a fracture in the midportion (arrow), or waist, of the scaphoid. Note that this fracture was not apparent on the standard anteroposterior wrist view.



Figure 83.3 Scaphoid fracture (arrow) in a child. The patient presented with wrist pain after a FOOSH mechanism. Examination demonstrated tenderness with no soft tissue swelling in the anatomic snuffbox; importantly, no tenderness was noted at the growth plate of the distal radius, which is the more likely fracture location in this particular patient population.

delay. As only 8–20% of patients immobilized will later be found to have a fracture, alternative strategies including computed tomography and magnetic resonance imaging have been suggested but are not common practice.

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1. Haisman JM, Rohde RS, Weiland AJ. Acute fractures of the scaphoid. *J Bone Joint Surg Am* 2006;88:2750–8.
2. Brooks S, Wluka AE, Stuckey S, Cicuttini F. The management of scaphoid fractures. *J Sci Med Sport* 2005;8:181–9.
3. Phillips TG, Reibach AM, Slominany WP. Diagnosis and management of scaphoid fractures. *Am Fam Physician* 2004;70(5): 879–84.

CASE 84 | Rash on a Child with Epilepsy

Answer: A

Diagnosis: Toxic epidermal necrolysis (secondary to phenytoin)

Discussion: There are a number of drug hypersensitivity syndromes reported in the literature, including erythema multiforme (EM), Stevens–Johnson syndrome (SJS), and toxic epidermal necrolysis (TEN). These three drug hypersensitivity syndromes represent a spectrum of a disease rather than being distinct clinical entities.

EM is an acute self-limited syndrome characterized by a distinctive clinical eruption, the hallmark of which is the target lesion. EM is further broken down into minor and major categories, with the latter describing mucus membrane involvement. The etiology is infectious approximately 90% of the time, with herpes simplex virus being the most common precipitator; medications have also been implicated. The initial lesion is a dull red macule that expands slightly to the classic target lesion. In the center, a small papule or vesicle develops, flattens, and then becomes clear. This is surrounded by a pale ring of edema, with the periphery of the lesion consisting of an erythematous ring.

SJS is an immune-complex-mediated hypersensitivity complex that is considered by some to be a severe expression of EM. SJS typically involves both the skin and the mucous membranes. Significant involvement of oral, nasal, eye, vaginal, urethral, gastrointestinal, and lower respiratory tract mucous membranes may develop in the course of the illness. SJS is characterized by a prodrome of fever and malaise, followed by the onset of skin manifestations. Skin sloughing is limited to less than 10% of the body surface area. The most common etiologic agents are medications (sulfa drugs, penicillin, antiepileptics, and nonsteroidal anti-inflammatory drugs [NSAIDs]) followed by infection. SJS is a dermatologic emergency with the potential for severe morbidity and death.

TEN is also an acute dermatologic emergency characterized by widespread erythematous macules and target lesions with full-thickness epidermal necrosis and involvement of more than 30% of the cutaneous surface. TEN is considered to be a more severe form of SJS. There is commonly a prodrome where the patient will complain of progressive skin tenderness, fever, malaise, conjunctival irritation, headache, myalgias, nausea, vomiting, and diarrhea. It is not uncommon for health care providers to misdiagnose the rash at the early stage as a simple viral illness. The skin lesions begin as morbilliform, EM-like, with initial tender erythema. Blisters then form and become confluent (Figure 84.1). The entire thickness of the epidermis becomes necrotic and shears off. A positive Nikolsky's sign is present if, when lateral pressure is put on the skin with the thumb, the epidermis appears to slide



Figure 84.1 Blisters noted from the case patient.

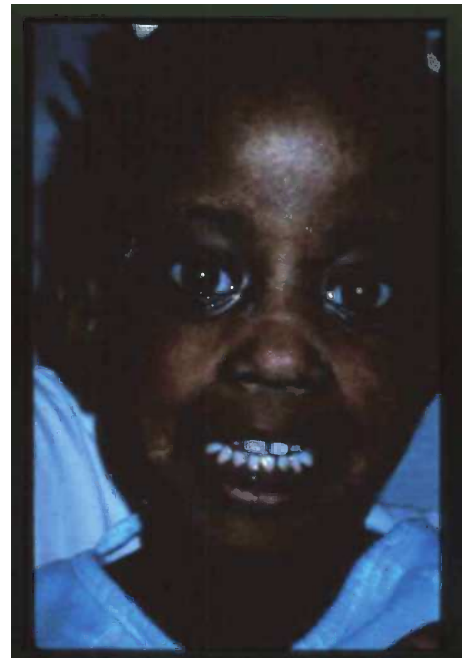


Figure 84.2 The patient in the case presentation survived, but with splotchy permanent depigmentation of her face.

over the underlying dermis. Nails may be lost. The scalp, palms, and soles may be less severely involved, but all mucus membranes (lips, buccal, conjunctival, genital, and anal) may be affected. Multiorgan involvement may occur, with blindness, respiratory failure, encephalitis, hepatitis, myocarditis, nephritis, and thyroiditis all reported. The etiology of TEN is much more likely to be from medications (sulfa drugs, penicillin, antiepileptics, and NSAIDs) than from infection or other causes. The mortality rate associated with TEN can approach 40%. Permanent depigmentation can occur if patients survive (Figure 84.2).

It is important to review the medication list when patients present with a rash. Healthcare providers commonly confuse drug hypersensitivity reactions with “viral exanthems” because there is often preceding fever and malaise.

For all drug hypersensitivity syndromes, prompt withdrawal of the suspected drug(s), good supportive care, and referral to a burn unit in cases of SJS or TEN are the mainstays of therapy. Beyond these simple measures, there is lack of strong supportive evidence of benefit of other specific therapies. Most authors reserve antibiotics for proven infections rather than prophylactic administration. Temporary semi-synthetic skin substitute application in areas of denuding has been shown to decrease pain, reduce fluid loss, reduce sepsis, and increase wound healing. Corticosteroids have long been used in the management of SJS/TEN. However, there are multiple studies documenting no demonstrable benefit to steroids for SJS/

TEN, and there is concern that steroids may increase the risk of sepsis. Intravenous immunoglobulin (IVIG) has been reported as a treatment for SJS and TEN and shows positive results in many studies, although more research is needed in this area.

Further reading

1. Chave TA, Mortimer NJ, Sladden MJ, et al. Toxic epidermal necrolysis: current evidence, practical management and future directions. *Br J Dermatol* 2005;153(2):241–53.
2. Letko E, Papaliodis DN, Papaliodis GN, et al. Stevens–Johnson syndrome and toxic epidermal necrolysis: a review of the literature. *Ann Allergy Asthma Immunol* 2005;94(4):419–36.
3. Forman R, Gideon K, Shear NH. Erythema multiforme, Stevens–Johnson syndrome and toxic epidermal necrolysis in children. A review of 10 years’ experience. *Drug Saf* 2002; 25(13): 965–72.

CASE 85 | Abdominal Pain in an Alcoholic

Answer: C

Diagnosis: Sentinel loop

Discussion: The term “sentinel loop” was first used in 1946 by Levitin. On a plain film, he described it as an isolated loop of distended adynamic bowel. A sentinel loop may be seen on abdominal radiograph when there is an adjacent localized inflammatory process in the peritoneal cavity (Figure 85.1). A segmental paralytic ileus affecting one or two loops of bowel overlying the inflamed area may subsequently occur. Gas and fluid accumulate in this isolated area of small bowel as the nearby inflammatory process leads to a focal decrease in peristalsis. In a sentinel loop, the bowel is dilated proximally due to spasm of the distal bowel that is adjacent to the localized area of inflammation.

There are various disease processes that may lead to the development of a sentinel loop on a radiograph. When found in the upper abdomen, a sentinel loop may be due to pancreatitis, cholecystitis, or less commonly pyelonephritis or splenic injury. In acute pancreatitis, while many various radiographic findings may appear on plain film, the sentinel loop is the most common and the most specific. In the lower abdominal quadrants, appendicitis, diverticulitis, and salpingitis may also lead to a sentinel loop. Other intra-abdominal inflammatory processes including intraperitoneal abscess may also lead to this finding on a plain abdominal film. The portion of the bowel involved often indicates the source of the underlying



Figure 85.1 Sentinel loop (arrow pointing to the area involved).

ing inflammatory disease: localized distended segments of the jejunum or transverse colon are seen with acute

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pancreatitis, the hepatic flexure of the colon may be dilated in acute cholecystitis, and the terminal ileum may be distended with appendicitis. The sentinel loop is a nonspecific radiographic finding and at times may be indistinguishable from a small or even large bowel obstruction.

Further reading

1. Ranson JH. Diagnostic standards for acute pancreatitis. *World J Surg* 1997;21(2):136–42.
2. Davis S, Parbhoo SP, Gibson MJ. The plain abdominal radiograph in acute pancreatitis. *Clin Radiol* 1980;31(1):87–93.

CASE 86 | Chest Pain with Electrocardiographic ST Segment and T Wave Abnormalities

Answer: A

Diagnosis: Left ventricular hypertrophy

Discussion: The patient's ECG noted in the case demonstrates a normal sinus rhythm with voltage criteria for left ventricular hypertrophy (an S wave in lead V1 plus an R wave in lead V6 greater than 35 mm) and ST segment changes (ST segment elevation in leads V1–V3, and ST segment depression/T wave inversion in leads I, aVL, V5, and V6). The ST segment/T wave changes in this left ventricular hypertrophy (LVH) pattern are termed the “strain pattern.”

In patients with LVH, ST segment/T wave changes are encountered in approximately 70% of cases; these changes result from altered repolarization of the ventricular myo-

cardium due to LVH, representing the new “norm.” These LVH-related ECG changes may mask and/or mimic the early findings consistent with acute coronary ischemia. LVH is associated with poor R wave progression and loss of the septal R wave in the right to midprecordial leads, most commonly producing a QS pattern (Figure 86.1). In general, these QS complexes are located in leads V1 and V2, rarely extending beyond lead V3. ST segment elevation is encountered in this distribution along with prominent T waves. The ST segment elevation seen in this distribution is usually 2–4 mm in height, although it may reach 5 mm or more – and may be difficult to distinguish from that associated with acute myocardial infarction (AMI). The initial, upsloping portion of the ST segment/T

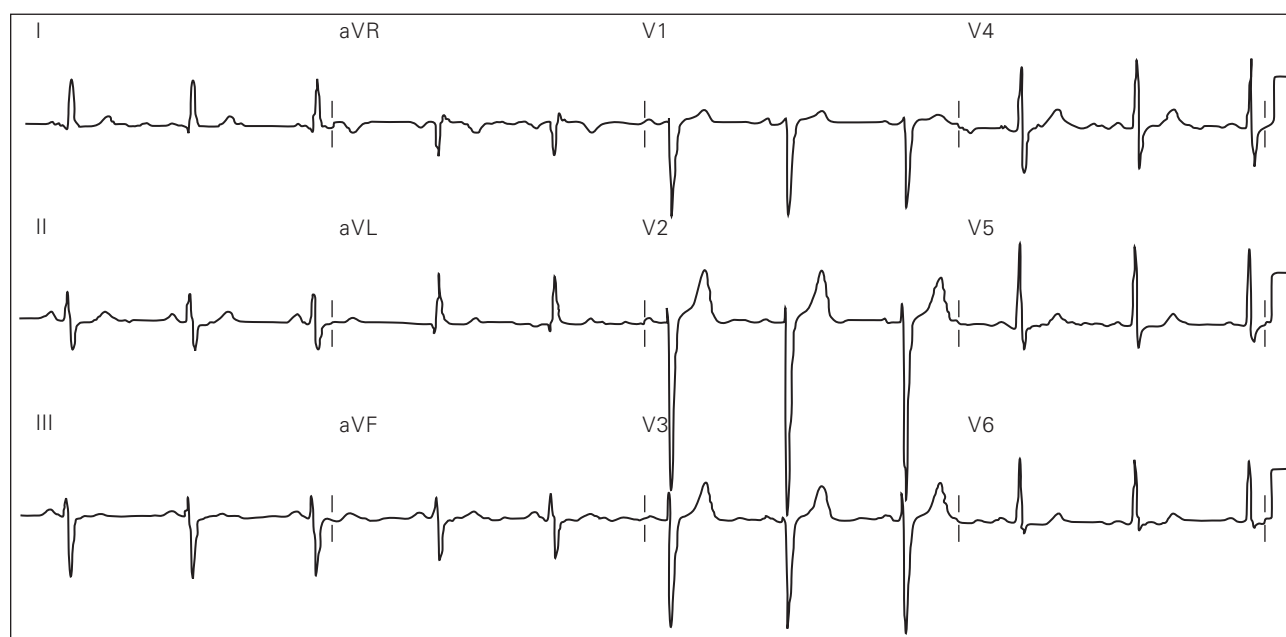


Figure 86.1 Normal sinus rhythm with voltage criteria for left ventricular hypertrophy (an S wave in lead V1 plus an R wave in lead V6 greater than 35 mm) and an absence of ST segment/T wave abnormalities of significance.

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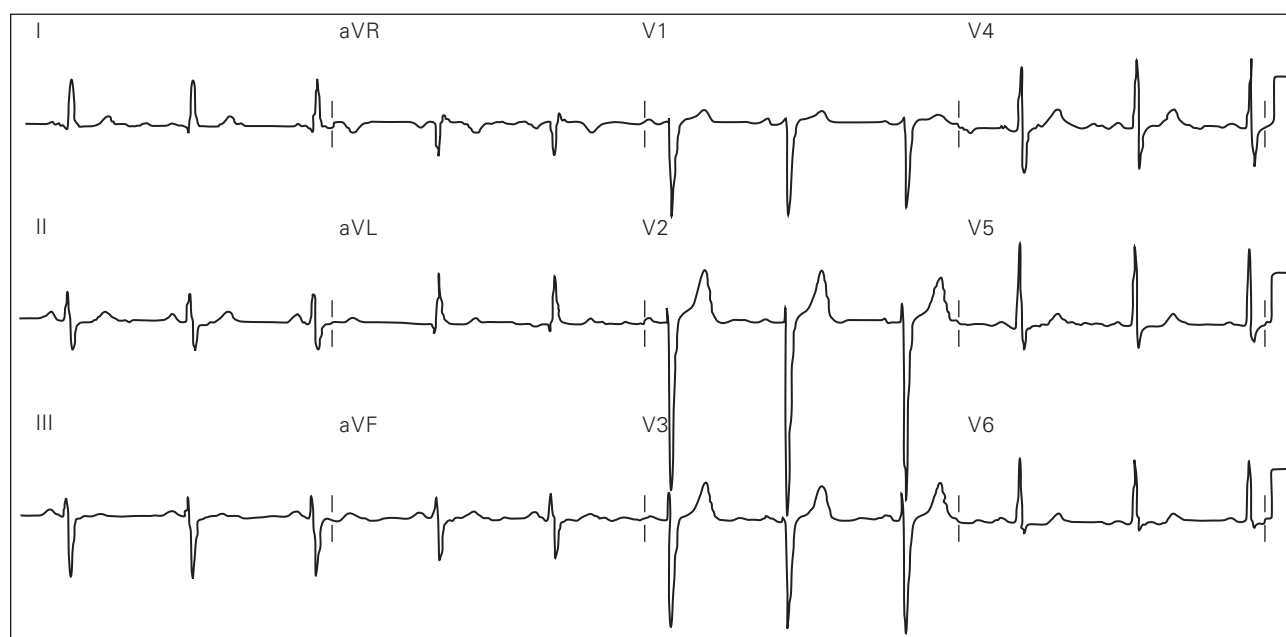


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wave complex is frequently concave in LVH, compared with the either flattened or convex pattern observed in the patient with AMI.

The “strain” pattern, characterized by downsloping ST segment depression with asymmetric, biphasic, or inverted T waves in leads with prominent R waves (the lateral leads I, aVL, V5, and V6), is frequently misinterpreted as acute ischemia. The ST segment/T wave complex has been described in the following manner: initially bowed upward (convex upward) followed by a gradual downward sloping into an inverted, asymmetric T wave with an abrupt return to the baseline. It is important to realize that significant variability may be encountered in the “strain” pattern. The T wave may be minimally inverted or the inversion may be greater than 5mm in

depth. These T wave abnormalities may also be encountered in patients lacking prominent voltage (i.e., large S and R waves).

Further reading

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CASE 87 | A Heroin Abuser with Multiple Skin Lesions

Answer: B

Diagnosis: Skin popping

Discussion: This case demonstrates skin findings consistent with cellulitis and multiple ulcerations suggestive of skin popping. Upon further questioning, the patient admitted to heroin use through subcutaneous injections. Figure 87.1 shows the fifth proximal phalanx projecting through the skin at a site of one of her skin popping ulcerations. The patient recalled that she had fallen on her hand approximately 1 month previously.

Skin popping (subcutaneous or intramuscular injection) is performed by drug abusers usually after intravenous access is no longer available secondary to sclerosis, thrombosis, dissection, or overlying infection of their veins. The techniques employed are often not sterile and involve the deposition of not only the abused drug, but

also contaminates, such as particulate matter and bacteria, subcutaneously. *Staphylococcus*, *Streptococcus*, and *Bacillus* species have been isolated from these wounds. Skin popping often results in abscess formation, cellulitis, or both. Deadly clostridial infections including tetanus, botulism, and necrotizing fasciitis may result from skin popping, especially when associated with black-tar heroin use.

Parenteral drug abusers are known to use many different routes of injection to obtain their fix (Figures 87.2–87.4). Careful physical examination should be performed on all suspected drug abusers. “Grand central station” is a rare practice that involves the injection of illicit drugs directly into the heart using the subxiphoid approach. Pocketing involves injecting drugs into the subclavian vein using a supraclavicular approach though the “pocket” palpated between the clavicle and the neck.



Figure 87.1 The skin popper of the chapter case with a different view of her hand revealing the proximal phalanx of her fifth digit protruding through the abscess.



Figure 87.2 Characteristic “track” marks of an intravenous drug abuser.

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Figure 87.3 Injection marks within the axilla of an intravenous drug abuser. The axilla was utilized to avoid detection.



Figure 87.4 Characteristic multiple abscesses on the leg of a skin popper.

Further reading

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2. Johnston C, Keogan MT. Imaging features of soft-tissue infections and other complications in drug users after direct subcutaneous injection (“skin popping”). *AJR Am J Roentgenol* 2004;182(5):1195–202.
3. Brown PD, Ebright JR. Skin and soft tissue infections in injection drug users. *Curr Infect Dis Rep* 2002;4(5):415–19.

CASE 88 | Chest Pain in a Middle-aged Male Patient with ST Segment Elevation

Answer: C

Diagnosis: ST segment elevation secondary to benign early repolarization

Discussion: The 12-lead ECG in this case demonstrates a normal sinus rhythm with ST segment elevation in the precordial leads. The elevated ST segment is concave with obvious elevation of the J point. These features are suggestive of benign early repolarization (BER).

The syndrome of BER is felt to be a normal variant not indicative of underlying cardiac disease or increased cardiovascular risk. BER has been reported in men and women of all age and ethnic groups; for unknown reasons, BER is seen more often in young individuals, men, and African-American persons. The mean age of patients with BER is approximately 40 years with the majority of individuals being less than 50 years of age.

The electrocardiographic definition of BER includes the following characteristics: (1) ST segment elevation; (2) upward concavity of the initial portion of the ST segment; (3) notching or slurring of the terminal QRS complex; (4) symmetric, concordant T waves of large amplitude; (5) widespread or diffuse distribution of ST segment eleva-

tion on the ECG; and (6) relative temporal stability. The ST segment elevation begins at the J point with the degree of J point elevation usually less than 3.5 mm. This ST segment elevation morphologically appears as if the ST segment has been evenly lifted upwards from the isoelectric baseline at the J point. This elevation results in a preservation of the normal concavity of the initial, upsloping portion of the ST segment/T wave complex (a very important electrocardiographic feature used to distinguish BER-related ST segment elevation from ST elevation associated with ST-elevation myocardial infarction [STEMI]).

With ST segment elevation, a concave morphology of the elevated segment is more often associated with a non-STEMI cause of the electrocardiographic abnormality, while a nonconcave (obliquely straight or convex) shape is seen in STEMI patients. This technique uses the morphology of the initial portion of the ST segment/T wave, defined as beginning at the J point and ending at the apex of the T wave (Figure 88.1C and 1D). Patients with non-infarctional ST segment elevation (i.e., with early repolarization; Figure 88.1C) tend to have a concave



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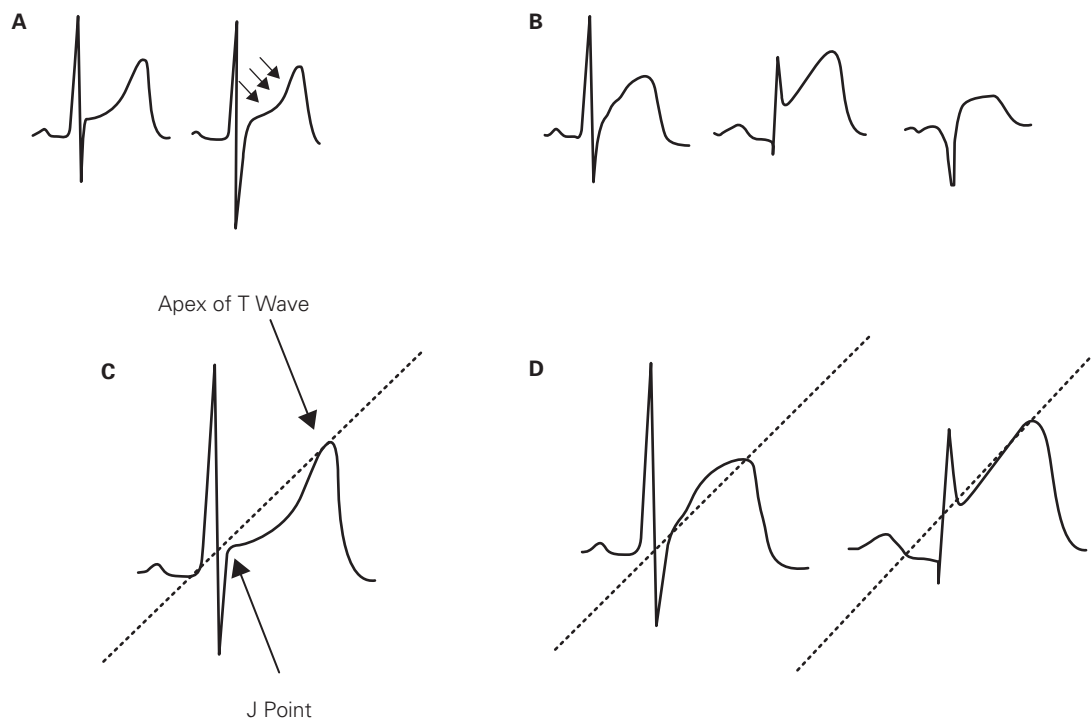


Figure 88.1 A. ST segment elevation in benign early repolarization. Note the concave nature of the elevated ST segment (arrows). B. ST segment elevation in STEMI. Note the convex or obliquely straight morphology of the elevated ST segment. C. Determination of the morphology of the elevated ST segment in benign early repolarization. The J point and apex of the T wave are located, and a line is drawn through these two points. If the ST segment is below the line, a non-STEMI cause of ST segment elevation is likely. D. Determination of the morphology of the elevated ST segment in STEMI. A line is drawn through the J point and the apex of the T wave; if the ST segment is above or superimposed on the ST segment, STEMI is a likely explanation of the elevated ST segment.

morphology of the waveform. Conversely, patients with ST segment elevation due to STEMI have either obliquely flat or convex waveforms (grouped together as nonconcave; Figure 88.1D). The use of this ST segment elevation waveform analysis in patients with chest pain in the emergency department is a very specific clinical tool – meaning that it should be used to rule in patients with STEMI. It must be stressed that this technique is not sensitive; it should not be used as a justification alone for ruling out STEMI. This morphologic observation should only be used as a guideline, and, as with most guidelines, it is not perfect. Atypical patterns of STEMI can present

with a concave pattern, while noninfarction causes of ST segment elevation can manifest a nonconcave morphology of the elevated segment.

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2. Brady WJ, Syverud SA, Beagle C, et al. Electrocardiographic ST segment elevation: the diagnosis of AMI by morphologic analysis of the ST segment. *Acad Emerg Med* 2001;8:961–7.

CASE 89 | Fire Victim with Hoarseness

Answer: E

Diagnosis: Smoke inhalation with associated burns

Discussion: A critical first step in the management of burn victims is assessing for possible airway compromise from smoke inhalation. Patients may initially present asymptotically, as symptoms may take up to 24 hours

to develop. However, a major pitfall in managing a patient with smoke inhalation is failing to appreciate that rapid deterioration may occur.

The patient may present with voice changes, cough, difficulty with airway secretions, dyspnea, or stridor. Wheezes, rales, or decreased lung sounds may be heard

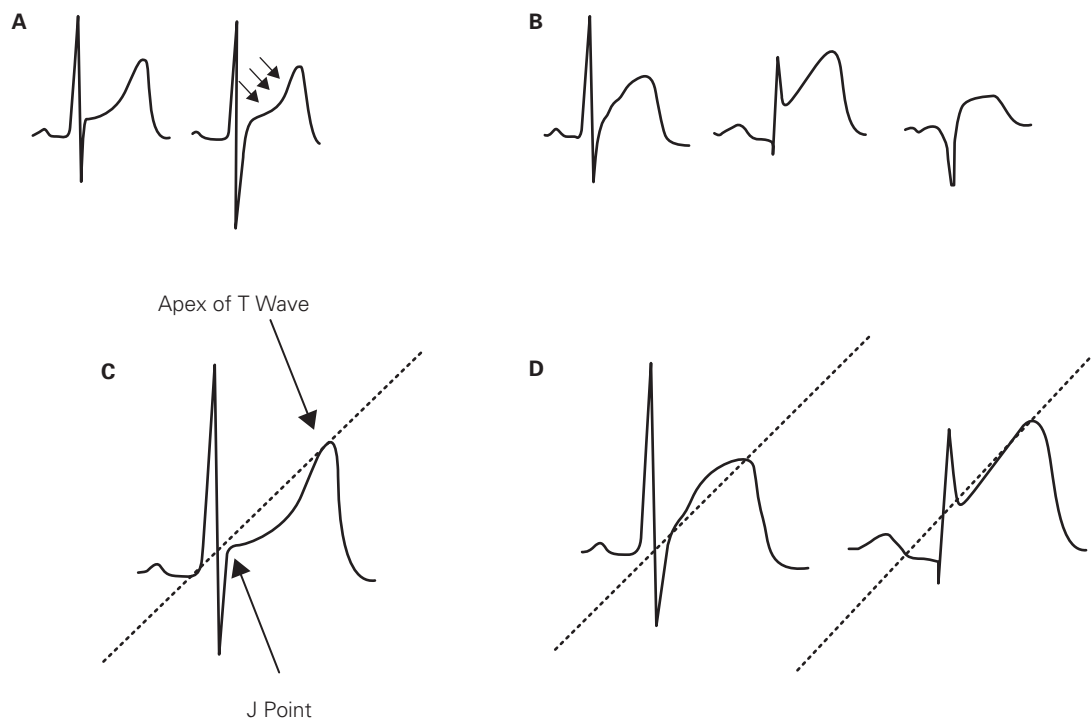


Figure 88.1 A. ST segment elevation in benign early repolarization. Note the concave nature of the elevated ST segment (arrows). B. ST segment elevation in STEMI. Note the convex or obliquely straight morphology of the elevated ST segment. C. Determination of the morphology of the elevated ST segment in benign early repolarization. The J point and apex of the T wave are located, and a line is drawn through these two points. If the ST segment is below the line, a non-STEMI cause of ST segment elevation is likely. D. Determination of the morphology of the elevated ST segment in STEMI. A line is drawn through the J point and the apex of the T wave; if the ST segment is above or superimposed on the ST segment, STEMI is a likely explanation of the elevated ST segment.

morphology of the waveform. Conversely, patients with ST segment elevation due to STEMI have either obliquely flat or convex waveforms (grouped together as nonconcave; Figure 88.1D). The use of this ST segment elevation waveform analysis in patients with chest pain in the emergency department is a very specific clinical tool – meaning that it should be used to rule in patients with STEMI. It must be stressed that this technique is not sensitive; it should not be used as a justification alone for ruling out STEMI. This morphologic observation should only be used as a guideline, and, as with most guidelines, it is not perfect. Atypical patterns of STEMI can present

with a concave pattern, while noninfarction causes of ST segment elevation can manifest a nonconcave morphology of the elevated segment.

Further reading

1. Brady WJ. Benign early repolarization: electrocardiographic manifestations and differentiation from other ST segment elevation syndromes. *Am J Emerg Med* 1998;16:592–7.
2. Brady WJ, Syverud SA, Beagle C, et al. Electrocardiographic ST segment elevation: the diagnosis of AMI by morphologic analysis of the ST segment. *Acad Emerg Med* 2001;8:961–7.

CASE 89 | Fire Victim with Hoarseness

Answer: E

Diagnosis: Smoke inhalation with associated burns

Discussion: A critical first step in the management of burn victims is assessing for possible airway compromise from smoke inhalation. Patients may initially present asymptotically, as symptoms may take up to 24 hours

to develop. However, a major pitfall in managing a patient with smoke inhalation is failing to appreciate that rapid deterioration may occur.

The patient may present with voice changes, cough, difficulty with airway secretions, dyspnea, or stridor. Wheezes, rales, or decreased lung sounds may be heard

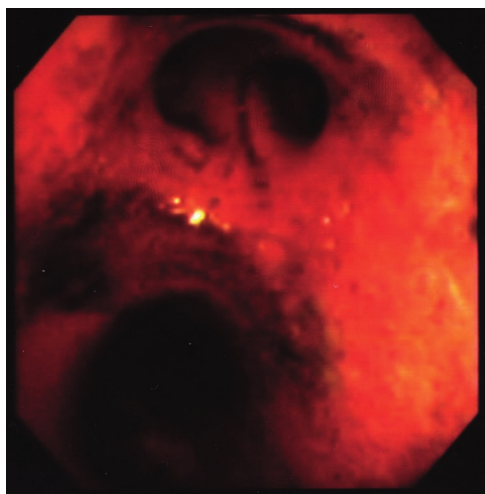


Figure 89.1 Bronchoscopy of the patient in this case. Note the edema of the airways and the black soot deposition on the mucosa.

on physical examination. Although traditionally these signs and symptoms have been used to indicate a need for intubation, they have recently been shown to be poor predictors of airway compromise. More important predictors, include facial burns, large body surface area burns, vocal cord edema, and soot in the oral cavity. Loss of consciousness, older age, and exposure to fire in an enclosed environment are also factors correlated with a higher likelihood of inhalation injury. The chest X-ray is normal early in presentation in the majority of patients, but if it is abnormal there is an increased risk of acute respiratory distress syndrome (ARDS). ARDS is defined as the presence of decreased oxygenation and bilateral pulmonary infiltrates, without left atrial hypertension. Even if none of these signs or symptoms is present, significant proximal and distal inhalation injury may be present.

Visualization of the vocal cords by direct laryngoscopy may be difficult secondary to edema, soot, and increased secretions (Figure 89.1). It is important to remember that

patients with large dermal burns will undergo aggressive fluid resuscitation. Large volumes of fluid resuscitation can be expected to cause airway edema. The hypopharynx, epiglottis, and aryepiglottic folds have a higher tendency to become edematous. Elevating the head of the bed can help reduce airway edema, as well as facial and neck swelling. If early intubation is not indicated, frequent repeat examinations are critical to determine changes in the patient's respiratory status.

Treatment of progressive respiratory failure includes mechanical ventilation, with constant positive airway pressure or positive end-expiratory pressure. This has been shown to minimize edema and improve oxygenation. Pulmonary edema may be a precursor to the development of ARDS. Systemic hypoxia can be seen as well if carbon monoxide or cyanide is inhaled by the patient. Carbon monoxide is the result of the incomplete combustion of carbon-containing materials. Determination of carbon monoxide toxicity requires co-oximetry to measure carboxyhemoglobin in the blood. It is treated with supplemental oxygen therapy, either with a high-flow nonrebreather or endotracheal tube, or, in certain circumstances, by hyperbaric oxygen therapy. Cyanide is a combustion product of synthetic materials that are often found in upholstery or carpets. Cyanide poisoning should be considered in burn patients with persistent cyanosis despite receiving 100% oxygen. It is treated with sodium nitrite and sodium thiosulfate or hydroxycobalamin.

Further reading

1. Boots RJ, Dulhunty JM, Paratz J, et al. Respiratory complications in burns: an evolving spectrum of injury. *Clin Pulm Med* 2009;16(3):132–8.
2. Lee AS, Mellins RB. Lung injury from smoke inhalation. *Paediatr Respir Rev* 2006;7:123–8.
3. Kuo DC, Jerrard DA. Environmental insults: smoke inhalation, submersion, diving, and high altitude. *Emerg Med Clin North Am* 2003;21(2):475–97.

CASE 90 | A Gardener with a Non-healing Rash

Answer: D

Diagnosis: Sporotrichosis

Discussion: Classically known as rose gardener's disease, sporotrichosis is caused by *Sporothrix schenckii*, a dimorphic fungus that is indigenous to many parts of the world. Although this yeast can cause systemic illness, it most commonly causes localized lymphocutaneous

disease. This organism preferentially grows in moss, hay, and soil, and therefore has a predilection for affecting gardeners, farmers, and those sustaining soil-contaminated trauma or animal bite wounds.

Lymphocutaneous disease occurs after a precipitating traumatic inoculation of the fungal spores. The trauma can be very benign, usually occurring secondary to a

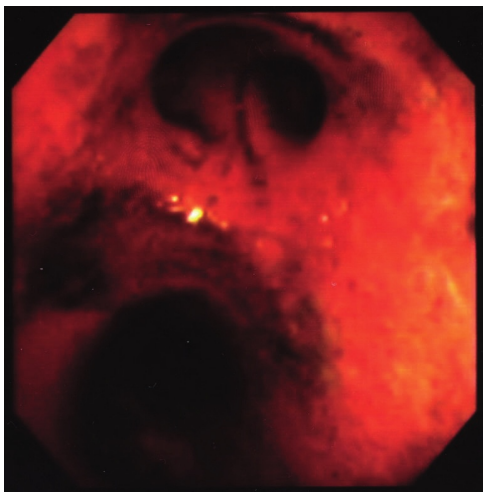


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Lymphocutaneous disease occurs after a precipitating traumatic inoculation of the fungal spores. The trauma can be very benign, usually occurring secondary to a

thorn or barb puncture or even a grass cut. A papular primary lesion follows, developing weeks to months later. These lesions often become nodular and eventually can ulcerate. With ongoing infection, new lesions continue to develop. These lesions advance along the lymphatics, proximal to the site of initial inoculation. Occasionally, however, patients will develop only a solitary, plaque-like lesion that usually does not ulcerate. Infections may be associated with regional lymphadenopathy and can mimic that of some species of mycobacteria as well as leishmaniasis, nocardia, and tularemia. The vast majority of cases involving *S. schenckii* are lymphocutaneous and occur in immunocompetent hosts. However, systemic illness (pulmonary and disseminated disease) can occur, although generally in the setting of patients who are immunosuppressed.

Definitive diagnosis of sporotrichosis can be made by aspirating some of the nongrossly purulent fluid from the individual lesions. Itraconazole is the drug of choice for combating lymphocutaneous disease, with amphotericin B being the therapy of choice for disseminated disease.

Further reading

1. Queiroz-Telles F, McGinnis MR, Salkin I, et al. Subcutaneous mycoses. *Infect Dis Clin North Am* 2003;17:59–85.
2. Kauffman CA, Hajjeh R, Chapman SW. For the Mycoses Study Group. Infectious Diseases Society of America. Practice guidelines for the management of patients with sporotrichosis. *Clin Infect Dis* 2000;30(4):684–7.
3. Kauffman CA. Sporotrichosis. *Clin Infect Dis* 1999;29(2):231–6.

CASE 91 | A Bite to the Leg in Tall Grass

Answer: D

Diagnosis: Crotalid envenomation

Discussion: Thousands of crotalid snakebites occur each year throughout the world. Crotalids may be distinguished from other species by their triangular-shaped heads, elliptically shaped pupils, and a single row of subcaudal scales (Figure 91.1). They also possess infrared heat-sensing pits, hence the name “pit viper,” which enable them to locate prey and guide the direction of strike.



Figure 91.1 Note the triangular-shaped head, the elliptically shaped pupils, and the heat-sensing pits of a copperhead snake (*Agkistrodon contortrix*).

The spectrum of clinical presentation ranges from asymptomatic to cardiovascular collapse and death. Bites from Crotalidae species that do not introduce venom (“dry bites”) have been estimated to occur in up to 20% of exposures, such as occurred in this case. Skin lesions may appear as distinct puncture marks or as faint scratches. Pain is frequently the initial complaint. When envenomation occurs, swelling usually begins within minutes of the bite. Tissue necrosis may follow cyanosis (Figure 91.2), and bleb formation may occur over the affected areas. In addition to direct tissue damage, rhabdomyolysis, nausea, vomiting, diaphoresis, and eventually shock may be seen. Three distinct snakebite-induced coagulopathies have been reported: venom-induced thrombocytopenia, fibrinolysis, and disseminated intravascular coagulation. Coagulopathy may manifest as petechiae, gastrointestinal and gingival bleeding, epistaxis, hemoptysis, and bleeding from wounds or phlebotomy sites.

Tourniquets, wound incisions, suction, extraction devices, cryotherapy, heat application, electric shock therapy, and wound excision should not be performed. The bite area should be gently cleansed. Circumferential measurement at several points along the affected limb should be marked with a permanent marker, noting time, shortly after the patient’s arrival and repeated with neurovascular checks at hourly intervals until swelling subsides.

In those cases where envenomation has occurred, hypotension may be seen secondary to fluid loss through third-spacing, vomiting, hemorrhage, or vasovagal effects. Crystalloid administration should begin immedi-

thorn or barb puncture or even a grass cut. A papular primary lesion follows, developing weeks to months later. These lesions often become nodular and eventually can ulcerate. With ongoing infection, new lesions continue to develop. These lesions advance along the lymphatics, proximal to the site of initial inoculation. Occasionally, however, patients will develop only a solitary, plaque-like lesion that usually does not ulcerate. Infections may be associated with regional lymphadenopathy and can mimic that of some species of mycobacteria as well as leishmaniasis, nocardia, and tularemia. The vast majority of cases involving *S. schenckii* are lymphocutaneous and occur in immunocompetent hosts. However, systemic illness (pulmonary and disseminated disease) can occur, although generally in the setting of patients who are immunosuppressed.

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Figure 91.2 A snakebite victim who was envenomated by a copperhead snake on his left ring finger. Note the marked tissue edema and necrosis that has developed around the bite site.

ately in these patients and prior to antivenom administration. Pain control usually requires intravenous opioid agents. Prophylactic antibiotics and steroid administration are not recommended.

In the United States, ovine polyvalent Fab immunoglobulin fragments (CroFab; Protherics Inc., Brentwood, Tennessee) is approved for treating North American crotaline envenomations. Dosing and mixing of these products can be found on the product insert. Pediatric patients should be treated with the same amount of antivenom as adults, regardless of their weight. The most critical decision facing the clinician treating snakebite victims is when antivenom therapy is appropriate. The major indications for antivenom therapy include rapid progression of swelling, significant coagulation defect, and cardiovascular collapse. Attempts have been made to quantify these signs and symptoms. Patients who receive antivenom must be monitored closely due to its shorter half-life creating a potential for delayed coagulopathy, thrombocytopenia, and bleeding. Patients who are asymptomatic or have minimal symptoms do not require antivenom.

Patients who remain asymptomatic for 4 hours after the snakebite and who have normal coagulation studies may be released. Symptomatic patients should be considered candidates for hospitalization and the need for antivenom therapy determined.

Further reading

1. Walter FG, Stolz U, Shirazi F, McNally J. Epidemiology of severe and fatal rattlesnake bites published in the American Association of Poison Control Centers' Annual Reports. *Clin Toxicol* 2009;47(7):663–9.
2. Lavonas EJ, Schaeffer TH, Kokko J, et al. Crotaline Fab antivenom appears to be effective in cases of severe North American pit viper envenomation: an integrative review. *BMC Emerg Med* 2009;9:13.
3. Singletary E, Rochman AS, Bodmer JCA, Holstege CP. Envenomations. *Med Clin North Am* 2005;89(6):1195–224.

CASE 92 | An Elderly Man with Diffuse Facial Edema

Answer: D

Diagnosis: Superior vena cava syndrome

Discussion: The superior vena cava (SVC) is the major conduit for venous blood return from the head, neck, upper extremities, and upper thorax. Obstruction of this blood vessel (i.e., compression, infiltration, or thrombosis) results in SVC syndrome (SVCS), which is characterized by elevated venous pressure in those structures drained by

the SVC. Early signs include periorbital edema and facial swelling that is more prominent in the morning upon awaking. Later signs include thoracic and neck vein distention, plethora of the face, as well as edema and cyanosis of the face and upper extremities. Headache, dyspnea, orthopnea, and cough are also common complaints.

Severity of symptoms in SVCS is dependent on the location of obstruction in relation to the azygos system of



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Severity of symptoms in SVCS is dependent on the location of obstruction in relation to the azygos system of

veins and the rate at which the SVC becomes obstructed. The azygos system of veins drain venous blood from the chest wall and esophagus and establishes important anastomoses with the inferior vena cava (IVC). Obstruction of the SVC above the level of azygos vein allows blood to bypass the SVC obstruction through chest wall collaterals and re-enter the SVC through the azygos venous system. In contrast, when the SVC is obstructed below the level of the azygos vein, blood must travel through the chest wall collateral veins to enter the azygos venous system, and subsequently must continue to flow through the azygos system to empty into the IVC. The longer and more convoluted course retards venous return and accounts for the development of more prominent symptoms. More prominent symptoms are also apparent with rapid onset of obstruction as less time is available for collateral blood flow to develop.

Historically, SVCS was associated with complications of syphilis and tuberculosis. Today, compression of the SVC by malignant mediastinal tumors accounts for approximately 90% of cases, most commonly from bronchogenic carcinoma (70%) and non-Hodgkin's lymphomas (10–15%). The most common histologic diagnosis is small cell lung carcinoma. Thrombosis of the SVC is a potential cause of SVCS in patients with a history of intravenous drug abuse and after central venous catheter placement.

Immediate management in the emergency department is aimed at alleviating patient symptoms and determining airway patency. Treatment options include supplemental oxygen, elevation of the patient's head, steroids, and diuretics. Depending on the etiology, both radiation therapy and chemotherapy are utilized as primary treatment options for the long-term management of SVC compression due to tumors.

The prognosis of patients treated for SVCS is dependent upon the underlying etiology. Histological diagnosis is essential as patients with SVCS resulting from bronchogenic carcinoma have a worse prognosis when compared with patients with lymphoma. Overall survival is estimated at 25% at 1 year and 10% at 30 months. The prognosis for SVCS not associated with malignancy is excellent; infectious or thrombotic causes respond to appropriate antibiotics or anticoagulation, respectively.

Further reading

1. Wan JF, Bezjak A. Superior vena cava syndrome. *Emerg Med Clin North Am* 2009;27(2):243–55.
2. Wudel LJ, Nesbitt JC. Superior vena cava syndrome. *Curr Treat Options Oncol* 2001;2(1):77–91.

CASE 93 | Acute-onset Double Vision

Answer: C

Diagnosis: Third cranial nerve palsy

Discussion: This patient has an isolated, pupil-involving third cranial nerve palsy of the left eye. The third cranial nerve innervates the superior, inferior, and medial recti muscles, as well as the inferior oblique muscle. In addition, parasympathetic fibers to the pupillary sphincter muscle run along the dorsal and peripheral aspects of the third cranial nerve. Patients with third nerve dysfunction typically present with a ptosis, limited ocular motility, and variable pupil involvement.

Isolated third nerve palsy with pupillary involvement must be presumed to be secondary to an aneurysm until proven otherwise. The most common site is at the junction of the posterior communicating artery and the internal carotid artery. A magnetic resonance imaging scan with contrast and magnetic resonance angiography should be obtained emergently.

Isolated pupil-sparing third nerve palsy implies complete loss of ocular motility with normal pupillary function. These palsies presumably result from microvascular

injury and are most often seen in older patients with hypertension or diabetes. Neuroimaging is not necessary in patients over 50 years of age if vasculopathic risk factors are present. These typically resolve spontaneously over 2–3 months.

Pain is not helpful in determining the etiology of a third nerve palsy. Even though most patients with aneurysmal third nerve palsies complain of pain, many microvascular third nerve palsies also present with pain. Neuro-ophthalmology or neurology consult is warranted for patients presenting to the emergency department with a third nerve palsy.

Further reading

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CASE 94 | Low Back Pain in a Car Accident Victim

Answer: B

Diagnosis: Anterior tear drop fracture at L5.

Discussion: Tear drop fractures result from extensive flexion and compression forces. Common mechanisms producing these forces are seen in motor vehicle crashes, sports injuries, diving accidents, and falls. Tear drop fractures are usually seen in the cervical spine, especially at C2 or C5/C6. They can occur at any level, however, and forced flexion/compression at the waist can cause a lumbar tear drop fracture (indicated by the arrow in Figure 94.1).



Figure 94.1 Lumbar lateral X-ray revealing a tear drop fracture of L5 (arrow).

All tear drop fractures should be treated as unstable regardless of where they occur. Instability results because there is often complete disruption of the ligamentous and bony elements. The anteroinferior fracture segment remains attached to the anterior longitudinal ligament, with retropulsion of the vertebral body into the spinal canal. Patients with this type of injury will often present with neurologic deficits secondary to cord impingement. Paraplegia and loss of pain, touch, and temperature sensation are common findings.

All trauma patients complaining of back pain or distracting injuries should receive prompt spine radiographs. Tear drop fractures are best seen on a standard lateral view of the spine. Fracture lines are typically seen along the anteroinferior border of the vertebral body, and prevertebral swelling of the soft tissues at the level of trauma combined with subluxation or dislocation of the interfacet joints characterize this injury. The posterior ligament complex, posterior longitudinal ligament, anterior longitudinal ligament, and intervertebral disc are all disrupted. Severe kyphosis at the injury site can lead to extensive cord damage.

Patients with radiographic and clinical evidence of a tear drop fracture should remain immobilized in spine precautions and urgently evaluated by a spinal cord injury team.

Further reading

1. Woolard A, Oussedik S. Injuries to the lumbar spine: identification and management. *Hosp Med* 2005;66(7):384–8.
2. Savitsky E, Votey S. Emergency department approach to acute thoracolumbar spine injury. *J Emerg Med* 1997;15(1):49–60.

CASE 95 | Pain and Rash Following Contact with a Caterpillar

Answer: D

Diagnosis: Buck moth caterpillar (*Hemileuca maia*) dermatitis (erucism)

Discussion: The buck moth caterpillar is prevalent in the southern United States and one of more than 50 species of caterpillars in the United States known to inflict a painful sting. Other venomous species in the United States include the puss (*Megalopyge opercularis*), saddle-back (*Sibine stimulea*; Figure 95.1), io moth (*Automeris io*),

gypsy moth (*Lymantria dispar*), browntail moth (*Euproctis chrysorrhoea*), hag moth (*Phobetron pithecium*), and tree processionary caterpillars (subfamily: Thaumetopoeidae). Only the larval form (caterpillar) of the organism is capable of envenomation.

Caterpillars transmit their venom through urticating hairs, spines, or setae distributed over their bodies. The spines of the buck moth caterpillar are branched, hollow, and connected to underlying venom glands. The

CASE 94 | Low Back Pain in a Car Accident Victim

Answer: B

Diagnosis: Anterior tear drop fracture at L5.

Discussion: Tear drop fractures result from extensive flexion and compression forces. Common mechanisms producing these forces are seen in motor vehicle crashes, sports injuries, diving accidents, and falls. Tear drop fractures are usually seen in the cervical spine, especially at C2 or C5/C6. They can occur at any level, however, and forced flexion/compression at the waist can cause a lumbar tear drop fracture (indicated by the arrow in Figure 94.1).



Figure 94.1 Lumbar lateral X-ray revealing a tear drop fracture of L5 (arrow).

All tear drop fractures should be treated as unstable regardless of where they occur. Instability results because there is often complete disruption of the ligamentous and bony elements. The anteroinferior fracture segment remains attached to the anterior longitudinal ligament, with retropulsion of the vertebral body into the spinal canal. Patients with this type of injury will often present with neurologic deficits secondary to cord impingement. Paraplegia and loss of pain, touch, and temperature sensation are common findings.

All trauma patients complaining of back pain or distracting injuries should receive prompt spine radiographs. Tear drop fractures are best seen on a standard lateral view of the spine. Fracture lines are typically seen along the anteroinferior border of the vertebral body, and prevertebral swelling of the soft tissues at the level of trauma combined with subluxation or dislocation of the interfacet joints characterize this injury. The posterior ligament complex, posterior longitudinal ligament, anterior longitudinal ligament, and intervertebral disc are all disrupted. Severe kyphosis at the injury site can lead to extensive cord damage.

Patients with radiographic and clinical evidence of a tear drop fracture should remain immobilized in spine precautions and urgently evaluated by a spinal cord injury team.

Further reading

1. Woolard A, Oussedik S. Injuries to the lumbar spine: identification and management. *Hosp Med* 2005;66(7):384–8.
2. Savitsky E, Votey S. Emergency department approach to acute thoracolumbar spine injury. *J Emerg Med* 1997;15(1):49–60.

CASE 95 | Pain and Rash Following Contact with a Caterpillar

Answer: D

Diagnosis: Buck moth caterpillar (*Hemileuca maia*) dermatitis (erucism)

Discussion: The buck moth caterpillar is prevalent in the southern United States and one of more than 50 species of caterpillars in the United States known to inflict a painful sting. Other venomous species in the United States include the puss (*Megalopyge opercularis*), saddleback (*Sibine stimulea*; Figure 95.1), io moth (*Automeris io*),

gypsy moth (*Lymantria dispar*), browntail moth (*Euproctis chrysorrhoea*), hag moth (*Phobetron pithecium*), and tree processionary caterpillars (subfamily: Thaumetopoeidae). Only the larval form (caterpillar) of the organism is capable of envenomation.

Caterpillars transmit their venom through urticating hairs, spines, or setae distributed over their bodies. The spines of the buck moth caterpillar are branched, hollow, and connected to underlying venom glands. The



Figure 95.1 Saddleback (*Sibine stimulea*).

pathogenic components of caterpillar venom are incompletely characterized but may include histamine, a histamine-releasing substance, proteases, and esterases. Caterpillar stings typically consist of urticarial dermatitis

but in some cases can progress to a systemic illness, known as lepidopterism, involving headache, conjunctivitis, and difficulty breathing. Atypical symptoms include radiating pain, lymphadenitis, muscle spasms, and abdominal pain.

The pathophysiology is likely a combination of mechanical, toxic, and allergic reactions. Treatment is supportive and includes stripping the area with adhesive tape to remove any embedded spines, then washing the site with soap and water, applying ice, and administering topical or oral antihistamines or corticosteroids. In this patient, the few remaining spines were removed with adhesive tape and he was treated with topical hydrocortisone (0.5% cream); his symptoms resolved within 5 days.

Further reading

1. Williams CM, Bellucci KS, Liu V, Levins P. Erythematous papular rash on the upper back area. Caterpillar dermatitis, or erucism. Arch Dermatol 2006;142:1501–6.
2. Diaz JH. The epidemiology, diagnosis, and management of caterpillar envenoming in the southern US. J La State Med Soc 2005;157:153–7.
3. Everson GW. Caterpillar envenomations: a prospective study of 112 cases. Vet Hum Toxicol 1990;32:114–19.

CASE 96 | Moonshine-induced Basal Ganglion Necrosis and Metabolic Acidosis

Answer: A

Diagnosis: Methanol poisoning

Discussion: Based on her apparent marked inebriation, her profound acidosis, and her computed tomography (CT) findings, a diagnosis of methanol toxicity was considered. Fomepizole and folate were administered, and the nephrology department was contacted for emergent dialysis. This patient was later found to have a nondetectable ethanol level, an osmolar gap of 68 mOsm/L, a lactate of 2.7 mmol/L (normal 0.5–2.2 mmol/L), and no crystals in her urine – further supporting the diagnosis of methanol toxicity. Her presenting methanol level was 168 mg/dL.

Methanol is a toxic alcohol metabolized to formaldehyde and formic acid. Methanol is inebriating. A high

anion gap metabolic acidosis with an elevated osmolar gap suggests a toxic alcohol poisoning. However, an anion gap acidosis may be absent early and an osmolar gap may be absent late in presentation. Cells of the retina and optic nerve are particularly susceptible to formic acid, resulting in visual loss and the classic “snowstorm” visual deficit. The basal ganglia (particularly the putamen) are also susceptible to damage, with necrosis or bleeding in this area as late findings in severe methanol poisoning. Bilateral basal ganglion hypodensities are not specific for methanol poisoning (Figure 96.1); however, in the setting of a patient with profound sedation and high anion gap metabolic acidosis, methanol poisoning should be considered.



Figure 96.1 CT of the brain showing hypodensities of the subcortical white matter (hollow arrows) and putamen (solid arrows).

Further reading

1. Eldridge DL, Dobson T, Brady W, Holstege CP. Utilizing diagnostic investigations in the poisoned patient. *Med Clin North Am* 2005;89(6):1079–105.
2. Yang CS, Tsai WJ, Lirng JF. Ocular manifestations and MRI findings in a case of methanol poisoning. *Eye* 2005;19(7):806–9.

CASE 97 | A Rock Climber with Finger Pain, Swelling, and Redness

Answer: A

Diagnosis: Bilateral paronychia

Discussion: At presentation, there was significant erythema and superficial skin necrosis on the patient's first digits bilaterally. Copious pus was expressed from both of the wounds. The patient was afebrile at presentation. After local anesthesia had been administered, bilateral incision and drainage of the cuticle regions was performed. Bacterial cultures were taken at this time. The patient was started on trimethoprim/sulfamethoxazole (two double-strength tablets daily for 7 days) due to concern about community-acquired methicillin-resistant *Staphylococcus aureus* (CA-MRSA) and instructed to return in 48 hours. The patient was also instructed to apply topical bacitracin at that time. Culture results showed 3+ group A beta-hemolytic *Streptococcus pyogenes*. Upon returning, the patient remained afebrile, and antibiotic coverage was changed to penicillin 500mg orally four times each day for 10 days to treat *Streptococcus pyogenes*. The patient continued to heal and returned to climbing 3 weeks after the original infection.

Paronychia is a common malady of the hand and among individuals who experience repeated trauma to the cuticular area. While acute paronychia is typically

unilateral, it can present bilaterally. Even though *Staphylococcus aureus* is the most common organism associated with acute paronychia, and CA-MRSA is an increasingly common cause of soft tissue infections presenting to the emergency department, *Streptococcus pyogenes* is also a frequent pathogen and must be considered. Recognition and proper treatment is important because untreated acute paronychia can cause permanent damage to the nail plate and progress to chronic paronychia.

Paronychia results from a disruption of the nail cuticle. The cuticle acts as a barrier to the external environment, sealing the space between the nailfold and the distal skin of the digit. When the cuticle is disrupted by trauma, pathogens can enter the lateral nailfolds. The most common pathogens (*Staphylococcus aureus* and *Streptococcus pyogenes*) reflect common skin fauna; however, if the site has been exposed to nail biting or finger sucking, oral flora can predominate. One to two days after *Streptococcus pyogenes* has gained access to the nailbed, the host raises a marked innate inflammatory response with emphasis on neutrophilic infiltration of infected tissue, resulting in pus formation.

Initial treatment of paronychia is composed of warm compresses with either warm saltwater, Burow's solution



Figure 96.1 CT of the brain showing hypodensities of the subcortical white matter (hollow arrows) and putamen (solid arrows).

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Initial treatment of paronychia is composed of warm compresses with either warm saltwater, Burow's solution

(aluminum acetate), or vinegar. Initially, if the infection fails to respond to these conservative treatment options, topical antibiotics can be used. However, if infection progresses, oral antibiotics should be initiated. The choice of antibiotic should reflect the mechanism of injury (i.e., superficial skin injury or mouth/nail biting injury), Gram stain results, and culture if available. Possible antibiotic treatment options include amoxicillin/clavulanate 500 mg/125 mg orally three times daily, clindamycin 150–450 mg orally three or four times daily, dicloxacillin 500 mg orally four times a day, cephalexin 500 mg orally four times a day, or trimethoprim/sulfamethoxazole two double-strength tablets orally twice daily for 7 days. Trimethoprim/sulfamethoxazole is recommended if the local prevalence of CA-MRSA is high or if significant CA-MRSA risk factors exist. Due to the sensitivity of *Streptococcus pyogenes* to penicillin, if this organism is cultured, penicillin V potassium 50 mg orally four times

daily for 10 days is recommended. If medical therapy alone fails to resolve the infection, surgical intervention should be considered. After administration of appropriate local anesthesia, drainage of an abscess can be accomplished with a number 11 blade or by tracking a 16- or 18-gauge needle tracked along the nailbed to allow drainage.

Further reading

1. Rigopoulos D, Larios G, Gregoriou S. Acute and chronic paronychia. *Am Fam Physician* 2008; 77(3): 339–34.
2. Moran GJ, Krishnadasan A, Gorwitz RJ, et al. Methicillin-resistant *S. aureus* infections among patients in the emergency department. *N Engl J Med* 2007;355(7):666–74.
3. Baran R, Barth J, Dawber RP. *Nail Disorders: Common Presenting Signs, Differential Diagnosis, and Treatment*. New York: Churchill Livingstone; 1991:93–100.

CASE 98 | Vomiting and Syncope Following Ingestion of Ramps

Answer: E

Diagnosis: *Veratrum viride* (false hellebore)

Discussion: The patient in this case consumed false hellebore (*Veratrum viride*), a member of the family Liliaceae, that grows in wet swamps, meadows, and woodlands along the Eastern Coast of the United States. Broad, fan-like leaves 6–12 inches long and 3–6 inches wide initially emerge from the ground in early spring on a leafy stalk that can grow up to 6 feet tall (Figure 98.1). Numerous greenish-yellow flowers are produced in open clusters from May to July.

Veratrum viride ingestion has been previously reported to have been mistakenly ingestion in individuals who foraged for ramps (also called wild leek), a member of the onion family. A tingling sensation of the tongue, nausea, vomiting, and hypotension are all commonly reported within a couple of hours of ingestion. Bradycardia, shortening of QT intervals, blockade of intraventricular conduction, peaked T waves, and depressed ST segments may all be seen on the ECG.

The acute characteristics of false hellebore consumption are mediated by toxic veratrum alkaloids. These compounds were used in the past for the acute control of hypertension, but a low therapeutic window limited their clinical viability. In experimental models on nerve and muscle, these alkaloids have been shown to cause persistent depolarization of excitable membranes through the activation of voltage-dependent sodium ion channels.



Figure 98.1 *Veratrum viride* growing in the woods of Virginia.

This ion shift delays repolarization, thus decreasing the threshold for membrane excitation, allowing a repetitive response to a single stimulus. This increased excitability is primarily seen on the afferent nerve fibers of the carotid sinus and left ventricle baroreceptors. The increase in afferent firing from these receptors results in a decrease in peripheral alpha-adrenergic tone, a vagally mediated bradycardia, and sensory paresthesias. The bradycardia may not be reversed with atropine due to the direct toxic effects of the alkaloids on the myocardium. The combina-

(aluminum acetate), or vinegar. Initially, if the infection fails to respond to these conservative treatment options, topical antibiotics can be used. However, if infection progresses, oral antibiotics should be initiated. The choice of antibiotic should reflect the mechanism of injury (i.e., superficial skin injury or mouth/nail biting injury), Gram stain results, and culture if available. Possible antibiotic treatment options include amoxicillin/clavulanate 500 mg/125 mg orally three times daily, clindamycin 150–450 mg orally three or four times daily, dicloxacillin 500 mg orally four times a day, cephalexin 500 mg orally four times a day, or trimethoprim/sulfamethoxazole two double-strength tablets orally twice daily for 7 days. Trimethoprim/sulfamethoxazole is recommended if the local prevalence of CA-MRSA is high or if significant CA-MRSA risk factors exist. Due to the sensitivity of *Streptococcus pyogenes* to penicillin, if this organism is cultured, penicillin V potassium 50 mg orally four times

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tion of vasodilatation and bradycardia caused by veratrum alkaloids is called the Bezold–Jarisch reflex.

The initial treatment of acute hellebore toxicity involves aggressive fluid resuscitation to maintain hemodynamic stability. In addition to fluids, atropine in 0.5–1.0 mg doses may be used in an attempt to reverse the vagally induced bradycardia. Dopamine has been reported to initiate a peripheral vasoconstriction if fluids are unable to resolve the hypotensive crisis. Nausea can be controlled with antiemetics. In the majority of case reports of *Veratrum viride* toxicity, complete resolution of symptoms occurs in less than 48 hours.

Further reading

1. Dyer S. Plant exposures: wilderness medicine. *Emerg Med Clin North Am* 2004;22:299–313.
2. Prince LA, Stork CM. Prolonged cardiotoxicity from poison lily (*Veratrum viride*). *Vet Human Toxicol* 2000;42(5):282–85.
3. Jaffe AM, Gephardt D, Courtemanche L. Poisoning due to ingestion of *Veratrum viride* (false hellebore). *J Emerg Med* 1990;8:161–7.

CASE 99 | Chest Pain and Subtle ST Segment Elevation

Answer: D

Diagnosis: Subtle ST elevation myocardial infarction with reciprocal change

Discussion: The patient's 12-lead ECG demonstrates subtle ST segment elevation in the inferior leads. The presence of ST segment depression in leads I and aVL, known as reciprocal ST segment depression or reciprocal change, confirms that the subtle ST segment elevation in the inferior leads results from ST elevation myocardial infarction (STEMI).

Reciprocal ST segment depression, also known as reciprocal change, is defined as ST segment depression in leads separate and distinct from leads reflecting ST segment elevation. The cause of reciprocal change remains unknown but may involve: (1) displacement of the injury current vector away from the infarcting myocardium; (2) coexisting distant ischemia; and/or (3) a manifestation of infarct extension. Regardless of its cause, reciprocal change in the setting of transmural acute myocardial infarction (AMI) identifies a patient with increased chance of poor outcome, and therefore an individual who may benefit from a more aggressive approach in the emergency department. Furthermore, its presence on the ECG supports the diagnosis of AMI with very high sensitivity and positive predictive values greater than 90%. Patients with inferior wall AMI manifest reciprocal change in approximately 75% of cases, while anterior wall myocardial infarcts demonstrate such ST segment depression much less often – usually in one-third of patients.

In a large prehospital chest pain population undergoing 12-lead ECG analysis, Otto and Aufderheide reported

that reciprocal ST segment depressions supported the diagnosis of AMI with both a high specificity and a high positive predictive value – both greater than 90%. In an emergency department-based chest pain population, it was noted that reciprocal ST segment depression was very useful in the electrocardiographic diagnosis of STEMI, with both a specificity and a positive predictive value of 93%. The presence of reciprocal changes has inadequate sensitivity to exclude STEMI, but its presence should alert the clinician to STEMI when analyzing ECGs with borderline or atypical ST segment elevations. Inferior AMI patients with precordial ST segment depression (i.e., reciprocal changes indicating extension to the posterior wall) or elevation in the right ventricular leads (i.e., extension to the right anterior ventricular wall) have a worse prognosis and presumably benefit more from fibrinolytic agents than patients with isolated inferior ST segment elevation.

Further reading

1. Otto LA, Aufderheide TP. Evaluation of ST segment elevation criteria for the prehospital electrocardiographic diagnosis of acute myocardial infarction. *Ann Emerg Med* 1994;23:17–24.
2. Brady WJ, Perron AD, Syverud SA, et al. Reciprocal ST segment depression: impact on the electrocardiographic diagnosis of ST-segment elevation acute myocardial infarction. *Am J Emerg Med* 2002;20:35–8.

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CASE 100 | Herbalist with Bradycardia and Vision Changes

Answer: E

Diagnosis: Cardiac glycoside toxicity due to foxglove ingestion

Discussion: The cardiac glycosides are potent cardiovascular agents that include digoxin and digitoxin. Several plants, including oleander (*Nerium oleander*), foxglove (*Digitalis purpurea*), and lily of the valley (*Convallaria majalis*), contain the cardiac glycosides. In this case, the patient was chronically ingesting foxglove as an herbal remedy and subsequently developed cardiac glycoside toxicity with hyperkalemia and a junctional bradycardia. The glycosides slow conduction through the atrioventricular (AV) node. When present at toxic levels, these agents impair conduction while increasing automaticity – most often producing ectopic rhythms at rapid rates. The signs and symptoms of cardiac glycoside intoxication depend on whether the poisoning is acute or chronic. In an acute ingestion, nausea and vomiting are prominent, along with hyperkalemia and cardiotoxicity manifested by dysrhythmias. In chronic intoxication, nonspecific symptoms such as malaise, weakness, and visual disturbances may be encountered, as well as cardiac dysrhythmias.

A broad range of cardiac dysrhythmias are seen in the patient with cardiac glycoside toxicity, including bradycardia, AV block, and tachycardia. The three classically described dysrhythmias that suggest the diagnosis include paroxysmal atrial tachycardia with block, junctional tachycardia, and ventricular tachycardia. Paroxysmal atrial tachycardia with block occurs progressively rather than being sudden in onset; in fact, the term “paroxysmal” is a misnomer. The atrial rate is usually between 150 and 250 beats per minute; the degree of AV block varies, with second-degree and Wenckebach being the most common forms.

Junctional rhythms, including junctional tachycardia, result from suppression of impulse formation at the sinoatrial node to the degree that the inherent AV pacemaker cells outpace the sinoatrial nodal cells. The escape rhythms result in a regular ventricular rate of 40–60 beats per minute, but accelerated junctional rhythms and junctional bradycardias are common. Ventricular tachycardia is a common manifestation of severe cardiac glycoside poisoning. As a result of increased automaticity, premature ventricular beats are often the earliest dysrhythmia associated with cardiac glycoside intoxication, and account for half of the dysrhythmias associated with digitalis. Bidirectional ventricular tachycardia is a rare dysrhythmia that is most commonly caused by cardiac glycoside toxicity.

Potential treatment for symptomatic patients with cardiac glycoside toxicity includes the administration of digoxin-specific Fab fragments. For coexisting hyperkalemia, the early administration of intravenous crystalloids, albuterol, sodium bicarbonate, and insulin with glucose should be performed to help decrease the hyperkalemia.

Further reading

1. Ma G, Brady WJ, Pollack M, Chan TC. Electrocardiographic manifestations: digitalis toxicity. *J Emerg Med* 2001;20:145–52.
2. Rich SA, Libera JM, Locke RJ. Treatment of foxglove extract poisoning with digoxin-specific Fab fragments. *Ann Emerg Med* 1993;22(12):1904–7.
3. Holstege CP, Eldridge DL, Rowden A. Electrocardiographic changes associated with poisoning. *Emerg Med Clin North Am* 2006;24(1):159–177.

CASE 101 | Painless Penile Ulcer

Andrea L. Neimann

Answer: D

Diagnosis: Chancre of primary syphilis

Discussion: Genital ulcers occur in sexually active individuals throughout the world. Physicians encountering patients with ulcers tend to rely heavily on history and physical examinations in order to make a diagnosis, but

this approach may be inappropriate. There is considerable variation and overlap in presentation, and generally additional diagnostic tests need to be performed. Also, concomitant infection with HIV can subtly alter the clinical presentation and compound the difficulty in diagnosing the cause of genital ulcers. Physicians need to use the

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Further reading

1. Ma G, Brady WJ, Pollack M, Chan TC. Electrocardiographic manifestations: digitalis toxicity. *J Emerg Med* 2001;20:145–52.
2. Rich SA, Libera JM, Locke RJ. Treatment of foxglove extract poisoning with digoxin-specific Fab fragments. *Ann Emerg Med* 1993;22(12):1904–7.
3. Holstege CP, Eldridge DL, Rowden A. Electrocardiographic changes associated with poisoning. *Emerg Med Clin North Am* 2006;24(1):159–177.

CASE 101 | Painless Penile Ulcer

Andrea L. Neimann

Answer: D

Diagnosis: Chancre of primary syphilis

Discussion: Genital ulcers occur in sexually active individuals throughout the world. Physicians encountering patients with ulcers tend to rely heavily on history and physical examinations in order to make a diagnosis, but

this approach may be inappropriate. There is considerable variation and overlap in presentation, and generally additional diagnostic tests need to be performed. Also, concomitant infection with HIV can subtly alter the clinical presentation and compound the difficulty in diagnosing the cause of genital ulcers. Physicians need to use the

opportunity of having the patient physically present to administer appropriate therapy under the assumption that follow-up of patients, although ideal, may not occur.

The Centers for Disease Control and Prevention (CDC) currently recommend an approach to the diagnosis and treatment of genital ulcers that relies heavily on clinical presentation and a knowledge of local epidemiologic data on the prevalence of causes of genital ulcers in a specific geographic area. In the United States, the three most common causes of genital ulcers in sexually active young adults are herpes simplex virus (HSV), syphilis, and chancroid. The typical clinical presentation of syphilis is a single painless, indurated ulcer with firm, nontender inguinal adenopathy. HSV tends to present with multiple vesicles or a cluster of painful ulcers preceded by vesiculopustular lesions. Tender inguinal lymph nodes are commonly associated. Chancroid ulcers tend to be multiple, painful, and purulent, and are often associated with inguinal lymphadenopathy with fluctuance or overlying erythema. The lymphadenopathy is often unilateral and is often painful. Lymphogranuloma venereum and granuloma inguinale rarely cause genital ulcers in the United States.

Diagnostic tests should be performed whenever possible and should be directed towards ascertaining the cause of the genital ulcer, as well as screening for commonly occurring co-infections with other sexually transmitted diseases (such as *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, HIV, hepatitis B, and hepatitis C). For syphilis, options to assist in making a correct diagnosis include: serologic tests (i.e., VDRL and RPR),

dark-field microscopy, and tissue biopsy. For HSV, one can do Tzanck smears, direct fluorescence antibody tests, viral cultures, or polymerase chain reaction. In the case of *Haemophilus ducreyi* (chancroid), Gram stain and culture on selective media is suggested.

Treatment should ideally be directed towards the identified cause. Since diagnostic tests are often not available at the time of presentation and may not always yield a specific cause, or if patient compliance is in question, empiric therapy should be based on the clinical presentation and the epidemiology of the etiologic agents in a given area. If necessary, patients may require treatment for HSV, syphilis, and chancroid (in areas of high incidence) on the day of their initial visit. Also, all patients should be offered HIV counseling and testing on the day of presentation, and they should be counseled about safe-sex practices. Follow-up should be encouraged to discuss laboratory results, ensure treatment was appropriate, and ascertain if healing of the ulcer has occurred. Finally, patients should be advised to encourage their partners to seek care for potential coexistent sexually transmitted disease.

Further reading

1. Lynn WA, Lightman S. Syphilis and HIV: a dangerous combination. *Lancet Infect Dis* 2004;4(7):456–66.
2. Workowski KA, Berman SM. Sexually Transmitted Diseases Treatment Guidelines, 2006. *MMWR*, 2006;55(RR11):1–94.

CASE 102 | Hyperthermia, Autonomic Instability, and Confusion in a Traveler

Answer: B

Diagnosis: Body packer with cocaine toxicity secondary to packet rupture

Discussion: The plastic bag contains multiple condom-wrapped packets of cocaine (Figures 102.1 and 102.2). This patient is a “body packer,” a person who ingests and transports packets of illicit drugs across country lines in order to evade customs officials. This should not be confused with a “body stuffer,” a person who quickly ingests illicit drugs (typically wrapped) to avoid detection by law enforcement officials.

This person demonstrates a sympathomimetic syndrome. On further questioning, this patient stated that he

was transporting packets of cocaine from Columbia to the United States. Beta-adrenergic antagonists, including mixed alpha- and beta-adrenergic antagonists, are contraindicated in cocaine toxicity. Beta-blockers can potentially induce unopposed alpha-agonist activity, placing the patient at risk for vasospasm. The patient should be treated with benzodiazepines, such as lorazepam, in an attempt to decrease his sympathomimetic state. Benzodiazepines should be titrated until the patient has calmed and his heart rate has diminished, which may take larger than typical doses. If marked hypertension persists despite benzodiazepines, nitrates and phenolamine can be utilized.

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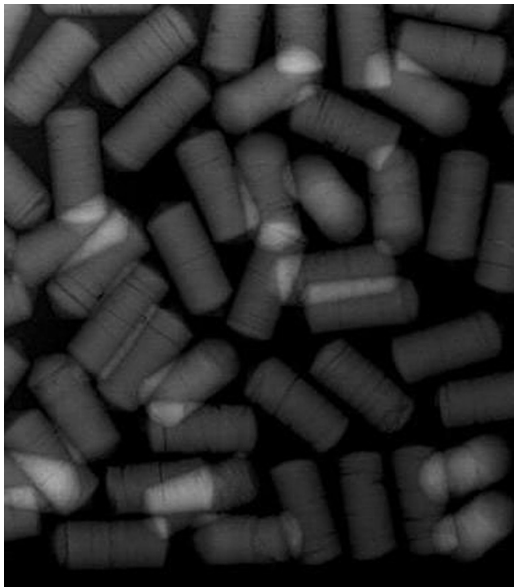


Figure 102.1 A radiograph of the bag of packets noted in the case. Taking a radiograph of the isolated packets, if available, may help to demonstrate their radiographic appearance and assist with locating them on a body packer's abdominal radiograph.



Figure 102.2 The abdominal radiograph from the case with arrows delineating a retained packet near the rectum. This film demonstrates the potential difficulty in localizing drug packets on plain radiograph.

In the asymptomatic packer, gastrointestinal decontamination with activated charcoal concurrently with polyethylene glycol is the mainstay of decreasing potential drug absorption and decreasing enteric transit time until rectal elimination.

If the patient were to develop cardiac dysrhythmias, sodium channel blocking agents such as procainamide should be avoided in cocaine toxicity; cocaine is itself a cardiac sodium channel blocker. If QRS prolongation or cardiac dysrhythmias developed, sodium bicarbonate should be the pharmacologic treatment administered first.

Further reading

1. Beno S, Calello D, Baluffi A, Henretig FM. Pediatric body packing: drug smuggling reaches a new low. *Pediatr Emerg Care* 2005;21(11):744–6.
2. Traub SJ, Hoffman RS, Nelson LS. Body packing – the internal concealment of illicit drugs. *N Engl J Med* 2003;349(26):2519–26.

CASE 103 | An Immigrant with Neck Swelling

Answer: D

Diagnosis: Tuberculous adenitis

Discussion: Tuberculosis (TB), an infection caused by bacilli of the *Mycobacterium tuberculosis* complex (MTB; *M. tuberculosis*, *M. bovis*, *M. africanum*, and *M. microti*), usually involving the lungs, causes more deaths worldwide than any other infectious disease. Infection typically occurs via inhalation of infected aerosolized respiratory droplet nuclei from an individual with active pulmonary TB and deposition of these droplets in the terminal alveoli. One-third of the world's population is estimated to harbor this

infection. Each year TB claims approximately 3 million lives, the vast majority in developing countries. TB saw a global resurgence in the 1990s, attributed largely to the human immunodeficiency virus (HIV) epidemic, although inadequate control programs, immigration from developing countries, and other social changes played major roles. In 1993, the World Health Organization declared TB a global health emergency.

The clinical manifestations of TB are varied and may reflect involvement of any system or organ. In immune-competent hosts, a vigorous granulomatous response

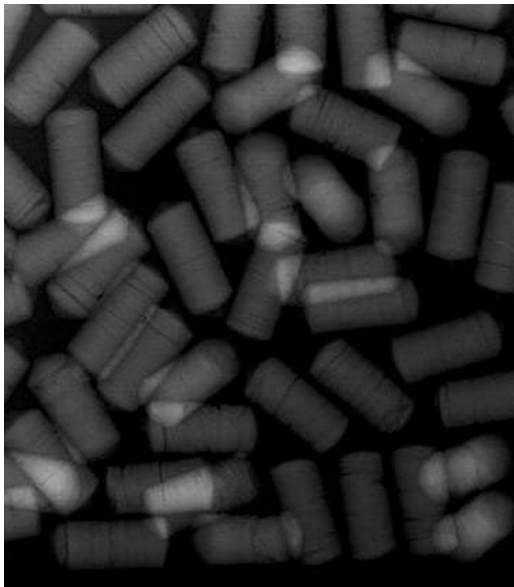


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The clinical manifestations of TB are varied and may reflect involvement of any system or organ. In immune-competent hosts, a vigorous granulomatous response

usually succeeds in stopping the progression of infection. In 10–20% of cases, infection results in clinical disease as a primary infection or after reactivation later in life. Around 5% of immunocompetent patients progress to active TB within 2 years of infection, and another 5% do so during the remainder of their lives. The likelihood of progression is increased 2–3-fold in persons with minor immunocompromise. In significantly immunocompromised individuals with HIV, one-third of patients will progress to disease within 3 months of infection. In most individuals, the lung serves as both the primary site of infection and the site of disease manifestation.

In the United States, 15% of patients manifested extrapulmonary TB before the emergence of HIV. Extrapulmonary TB, alone or coexistent with pulmonary TB, affects up to two-thirds of those with HIV. Extrapulmonary TB is also more common at the extremes of age and in immigrants/refugees from developing countries. Tuberculous adenitis (scrofula) is the most common form, occurring in more than 40% of those with infection outside the lungs. In industrialized countries, most cases of lymphadenitis occur in the second and third decades of life. A history of a positive contact (21.8%) and prior infection (16.1%) is present in approximately 16.1% of cases. More than 90% of palpable tuberculous lymph nodes occur in the head and neck area. Commonly, several nodes within a chain are involved, with bilateral involvement not uncommon. The posterior cervical lymph node chain and the supraclavicular region are most frequently involved. Generalized lymphadenopathy and hepatosplenomegaly are uncommon. Lymph nodes usually enlarge painlessly and slowly over weeks to months. Most untreated individuals will develop a chronically draining sinus tract. Systemic symptoms, if present, are usually not prominent.

Computed tomography and magnetic resonance imaging are useful management adjuncts. Findings reflect different stages in the disease process, including the presence and degree of granuloma formation, caseation and liquefaction necrosis, calcification, and fibrosis, with several nodal patterns seen. The presence of a multiloculated mass, with central lucency and a thick rim of enhancement, and minimally effaced fascial planes, is highly suggestive, particularly if a tuberculin skin test is positive. Plain chest radiographs may or may not be abnormal.

Definitive diagnosis requires isolation of the organism in culture. Tuberculous and nontuberculous mycobacte-

rial lymphadenitis must be differentiated, as their disease processes and treatment are significantly different. Fine-needle aspiration is the diagnostic modality of choice, as incisional biopsies may spread infection and can lead to sinus tract formation. Fine-needle aspiration (sensitivity 77%, specificity 93%) has a positive predictive value close to 100%. Histopathology shows epithelioid cell granuloma with or without giant cells and caseation necrosis. MTB organisms may be seen within a granuloma but are often rare. The most reliable criteria on fine biopsy material are the presence of acid-fast bacilli on staining and a positive culture. Definitive diagnosis is based on objective identification of the organism in culture, which takes 4–6 weeks. Polymerase chain reaction (PCR) is a helpful adjunct in the early diagnosis and initiation of therapy (sensitivity 43–84%, specificity 75–100%). PCR is positive with as few as 10 organisms.

Mycobacterial lymphadenitis is a systemic process; therefore, systemic antimycobacterial therapy is standard. The current regimen of choice is 2 months of intensive chemotherapy with daily isoniazid, rifampin, and pyrazinamide, supplemented with ethambutol or streptomycin if the prevalence of isoniazid resistance in the community is 4% or higher. If the organism is susceptible, isoniazid and rifampin are continued three times weekly for an additional 4 months. Baseline testing should include visual acuity and a platelet count, blood urea nitrogen and creatinine, uric acid, hepatic transaminases, and bilirubin level. Further evaluation for liver toxicity is recommended in at least the first and third months, and by patient symptom development suggesting toxicity. Treatment is guided by patient response and drug sensitivity testing on culture. Appropriately completed regimens approach 100% efficacy. Surgery alone has shown disappointing results, with a high rate of fistulization and recurrence noted. Close contacts should be evaluated by Public Health.

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2. Schneider E, Castro KG. Epidemiology of tuberculosis in the United States. *Clin Chest Med* 2005;26(2):183–95.
3. Kanlikama M, Mumbuc S, Bayarir Y, Sirikci A. Management strategy of mycobacterial cervical lymphadenitis. *J Laryngol Otol* 2000;114:274–8.

CASE 104 | Eyelid Laceration Following a Brawl

Answer: D

Diagnosis: Full-thickness lid laceration

Discussion: This patient has two full-thickness lid lacerations to the left lower lid. When a patient presents with an apparent isolated lid laceration, it is necessary to first exclude globe injury or rupture. Determining the mechanism of injury with a thorough history will help direct management. Complete ocular examination is necessary to rule out globe injury. Examination should include visual acuity, pupils, extraocular motility, external adnexa, slit-lamp examination, tonometry, and dilated fundus examination. Computed tomography scan of the brain and orbit (axial and coronal views), using 1–3 mm cuts, should be obtained when a foreign body or globe rupture is suspected. Tetanus prophylaxis should be given when indicated.

The presence of fat in a periocular wound indicates that the orbital septum has been violated. In these cases, it is

necessary to determine if damage to the levator muscle has occurred. Lacerations occurring in the medial canthal area require evaluation of the lacrimal drainage system.

Many eyelid lacerations can be repaired in the emergency room. Lid lacerations requiring repair in the operating room include those involving the lacrimal drainage apparatus, involvement of the levator muscle, extensive tissue loss, or associated globe trauma requiring surgery.

Further reading

1. Chang EL, Rubin PA. Management of complex eyelid lacerations. *Int Ophthalmol Clin* 2002;42(3):187–201.
2. Larian B, Wong B, Crumley RL, et al. Facial trauma and ocular/orbital injury. *J Craniomaxillofac Trauma* 1999;5(4):15–24.

CASE 105 | Young Athlete with Back Pain

Answer: D

Diagnosis: Pars defect at L5

Discussion: Lower back pain in a young athletic patient is a common phenomenon. Often, these complaints are nonspecific. Substantial decrease in performance and recurrence of symptoms can be important historical elements.

Pars defect (spondylolysis) is a defect of the posterior bony spine consisting of an interruption in the vertebral arch between the superior and inferior articular processes (pars interarticularis). The majority (90%) of cases occur at L5, although other lumbar vertebrae may be involved. The condition is most commonly bilateral, but unilateral defects are observed. The pathophysiology of spondylolysis appears to center around repeated trauma to the pars interarticularis, giving rise to stress fractures of the arch. Pre-existing spinal abnormalities such as spina bifida occulta are associated with a higher risk of spondylolysis. Some believe that there is a genetic component to spondylolysis, but this remains controversial.

Spondylolysis is more common in men and young athletes who participate in sports such as football, soccer, gymnastics, wrestling, and tennis. The disorder is often asymptomatic but can be associated with significant mor-

bidity. Patients with bilateral spondylolysis can progress to spondylolisthesis – a forward slippage of the adjacent vertebrae.

Evaluation in the emergency department should include a thorough neurologic examination to assess for any significant deficits, which might signify a more serious lesion. Careful attention should be paid to range of motion abnormalities. Often pain on extension or rotation of the lumbar spine may be the only finding on examination. Plain radiographs of the lumbar spine, consisting of anteroposterior, lateral, and oblique views should be obtained. On a normal oblique view, the posterior spinal elements form a “Scotty dog” appearance (Figure 105.1). A fracture line through the neck of the Scotty dog signifies a disruption of the pars interarticularis. Magnetic resonance imaging, computed tomography scanning, and single photon emission computed tomography can be useful adjuncts for diagnosis.

Management in the emergency department includes analgesia and activity limitation. Consultation with a spine specialist may be necessary if symptoms persist despite activity limitation. Bracing and surgery may be needed if there is no response to conservative management.



Figure 105.1 A. Oblique projection radiograph (same patient as noted in the case) demonstrates the presence of a pars defect. B. This resembles a Scotty dog with a collar (drawn and arrowed).

Further reading

1. Bono CM. Low-back pain in athletes. *J Bone Joint Surg Am* 2004;86-A(2):382–96.
2. Greenan TJ. Diagnostic imaging of sports-related spinal disorders. *Clin Sports Med* 1993;12(3):487–505.

CASE 106 | Chest Pain and Hypotension in an Adult Male Patient

Answer: B

Diagnosis: Inferoposterior right ventricular acute myocardial infarction

Discussion: The ECG seen in the case reveals sinus bradycardia at approximately 50 beats per minute with ST segment elevation in leads III and aVF consistent with inferior wall ST elevation myocardial infarction (STEMI); additionally, ST segment depression is seen in leads V1–V3, consistent with either posterior wall acute myocardial infarction (AMI) or anterior wall ischemia; posterior ECG leads V8 and V9 (Figure 106.1Aiii) demonstrate ST segment elevation, confirming posterior wall AMI. Lastly, ST segment depression with T wave inversion (see the case ECG) is noted in leads I and aVL, consistent with reciprocal change.

Posterior wall myocardial infarction refers to AMI of the posterior wall of the left ventricle. This region of the heart is usually perfused by branches of the right coronary artery (prominent posterolateral or posterior descending arteries) or the left circumflex artery. As such, the 12-lead ECG will usually demonstrate an inferior or lateral wall STEMI as well as ST segment depression, prominent R waves, and upright T waves in the right precordial leads (Figure 106.1Ai and ii). Myocardial inf-

arction involving the posterior wall usually occurs in conjunction with inferior or lateral AMIs; isolated posterior wall myocardial infarction, however, is encountered yet less frequently.

The use of posterior ECG leads is more helpful in the evaluation of posterior wall AMI when compared with the standard 12-lead ECG. ST segment elevation greater than 1 mm in leads V8 and V9 confirms the diagnosis of posterior myocardial infarction (Figure 106.1Aiii). In fact, the presence of ST segment elevation in the posterior ECG leads is more indicative of posterior AMI than the findings observed in leads V1–V3. The sensitivity of the posterior ECG leads may be as high as 90% for identifying posterior AMI. The magnitude of ST segment elevation is less pronounced in the posterior ECG leads – the posterior leads are located distant from the myocardium, allowing for more resistance to current flow and less pronounced ST segment elevation.

Right ventricular myocardial infarction presents with hypotension, elevated jugular venous pressure, and clear lung fields; the ECG demonstrates ST segment elevation in the inferior (see the case ECG) and right ventricular leads (Figure 106.1Bi and ii). Right ventricular myocardial infarction occurs in approximately one-third of inferior

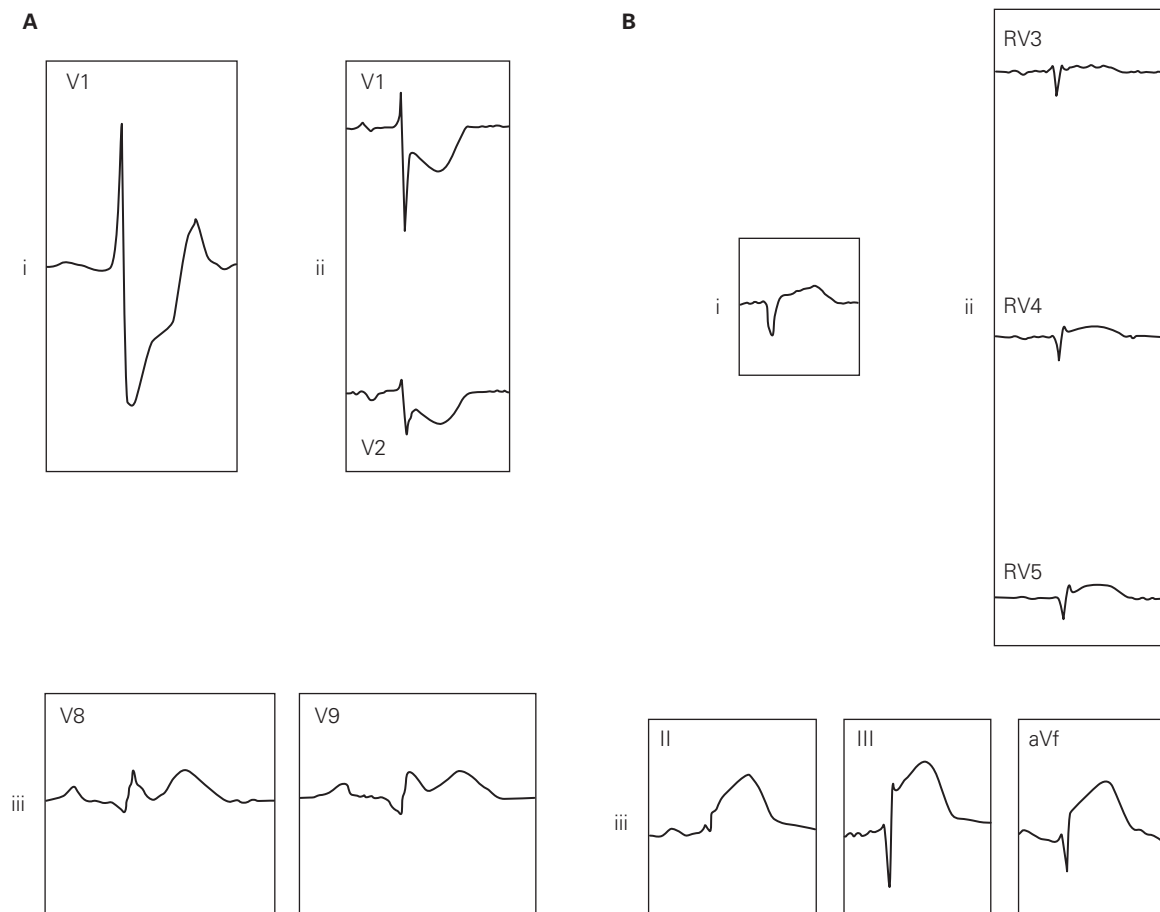


Figure 106.1 A. Posterior wall AMI. i. Lead V1 with ST segment depression, an upright T wave, and a prominent R wave consistent with posterior wall AMI. ii. Leads V1 and V2 with ST segment depression and an upright T wave, consistent with posterior wall AMI. iii. Posterior leads V8 and V9 with ST segment elevation, consistent with posterior wall AMI. B. Right ventricular AMI. i. Minimal ST segment elevation in lead V1 as seen in right ventricular AMI. ii. Minimal ST segment elevation in leads RV3–RV5 as seen in right ventricular AMI. iii. Inferior leads II, III, and aVF in a patient with inferior wall AMI with right ventricular infarction; note the relatively greater magnitude of ST segment elevation in lead III compared with the other inferior leads. This relative imbalance of lead III ST segment elevation results from the axis of imaging of lead III, which most closely observes the right ventricle.

wall AMIs. The 12-lead ECG reveals ST segment elevation in the inferior leads, with the greatest magnitude of elevation in lead III compared with the other leads (Figure 106.1Biii); furthermore, lead V1 may also demonstrate ST segment elevation in that this lead (Figure 106.1Bi), of all the standard leads, most closely images the right ventricle. The use of additional leads greatly increases the ability to diagnose right ventricular infarction.

The addition of lead RV4 provides objective evidence of right ventricular involvement – more so than that noted on the 12-lead ECG. RV infarction is diagnosed with 80–100% sensitivity by ST segment elevation greater than 1 mm in lead RV4. Alternatively, the clinician can use an entire reversal of the precordial leads, namely RV1–RV6 (Figure 106.1Bii); in a comparison to the use of single-lead RV4, the entire array did not increase the diagnostic ability of the additional lead approach. As with the posterior leads, the magnitude of the ST segment elevation

is less pronounced than is usually seen in the standard 12 leads of the ECG; this relatively less pronounced magnitude results from the fact that the right ventricle is composed of considerably less muscle than the left ventricle.

Further reading

1. Brady WJ, Hwang V, Sullivan R, et al. A comparison of 12- and 15-lead ECGs in ED chest pain patients: impact on diagnosis, therapy, and disposition. *Am J Emerg Med* 2000;18:239–43.
2. Haji SA, Movahed A. Right ventricular infarction – diagnosis and treatment. *Clin Cardiol* 2000; 23: 473–82.
3. Zalenski RG, Rydman RJ, Sloan EP, et al. Value of posterior and right ventricular leads in comparison to the standard 12-lead electrocardiogram in Evaluation of ST-segment elevation in suspected acute myocardial infarction. *Am J Cardiol* 1997;79: 1585–97.



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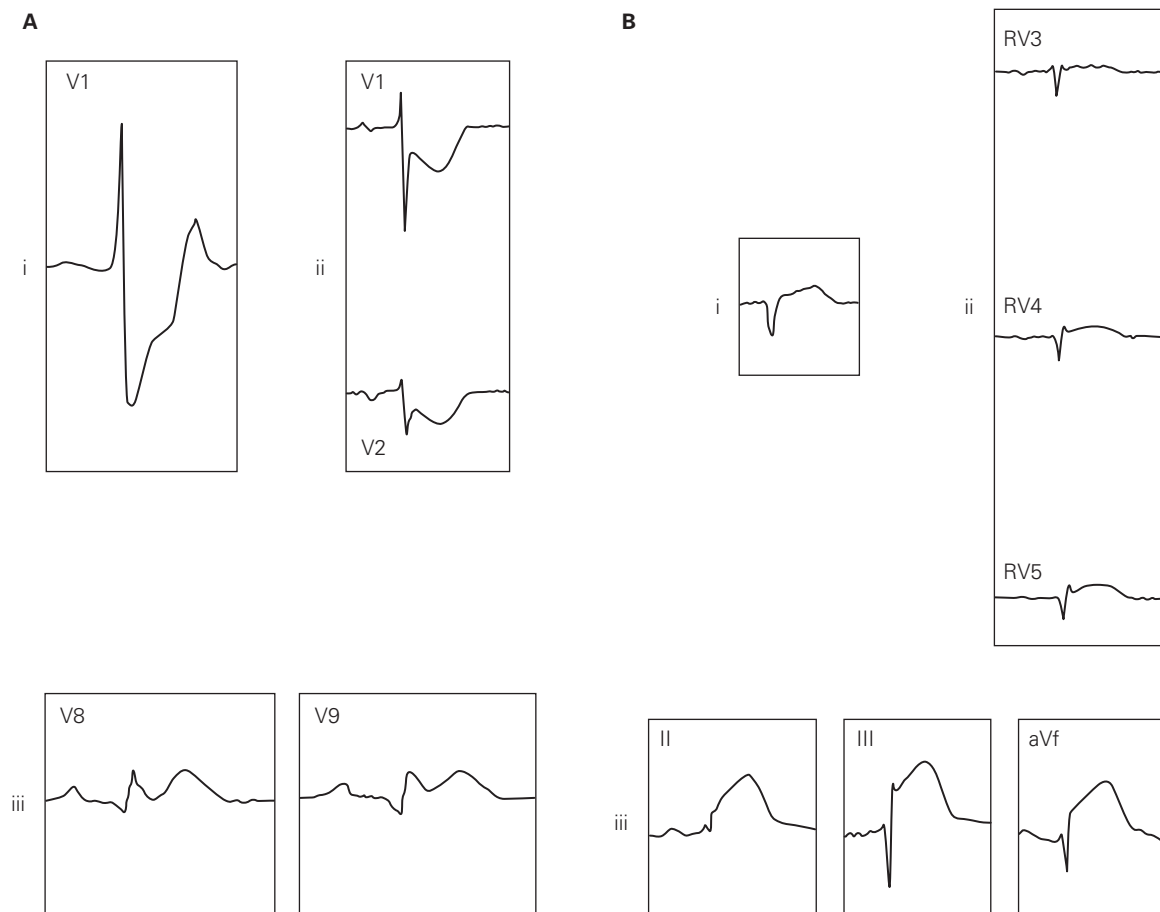


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CASE 107 | Adult Male with Atraumatic Lower Back Pain and Leg Weakness

Answer: D

Diagnosis: Cauda equina syndrome

Discussion: Cauda equina syndrome (CES) is a neurologic disorder that is caused by compression of the spinal nerve roots comprising the cauda equina, the terminus of the spinal cord. CES presents classically with lower extremity weakness, perineal numbness, and bladder and/or bowel dysfunction. The usual etiology is lumbar disc herniation; other causes include metastasis to the spine, hematoma, abscess, fracture with fragment compression, and transverse myelitis. The typical patient is an adult male in the fourth and fifth decade with disc herniation and a history of recent lower back discomfort; less commonly, patients will present with simultaneous new-onset back pain and CES. CES is an uncommon presentation, with 1 in 2,500 lower back pain patients exhibiting the syndrome.

The history reveals lower back pain associated with lower extremity weakness, perineal numbness, and bladder and/or bowel dysfunction. The physical examination demonstrates combined motor and sensory deficits. Neurologic deficits include bilateral leg weakness, a positive straight leg raise, decreased deep tendon reflexes, saddle anesthesia, and bladder retention or incontinence. Three bedside maneuvers will assist the clinician in the consideration of CES: a rectal examination, postvoid residual urine, and straight leg raise. The rectal examination, assessing perineal sensation and anal sphincter tone, is the first important step. Then a postvoid residual urine should be measured; values greater than 100 mL of urine should prompt concern. Urinary retention is both sensitive and specific for the diagnosis. Finally, a straight leg raise should be attempted to further evaluate for suspected radicular symptoms.

The suspicion for the diagnosis is raised by an awareness of the syndrome coupled with clinical suspicion for CES. Confirmatory evidence is supplied by advanced radiographic imaging. Initially, a plain view radiograph is performed to rule out lumbar fracture, and this film will likely be normal or nonspecifically abnormal in this presentation. Additional appropriate imaging includes magnetic resonance imaging (MRI). Ideally, all patients with suspected CES should undergo MRI of the spine for confirmation and localization of the lesion (Figure 107.1). If MRI is not available, computed tomographic myelography is an alternative imaging tool.

In the emergency department, treatment should include intravenous steroids and surgical consultation. Steroid therapy is recommended early in the course of evaluation; dexamethasone at a dose of 6–8 mg is a reasonable

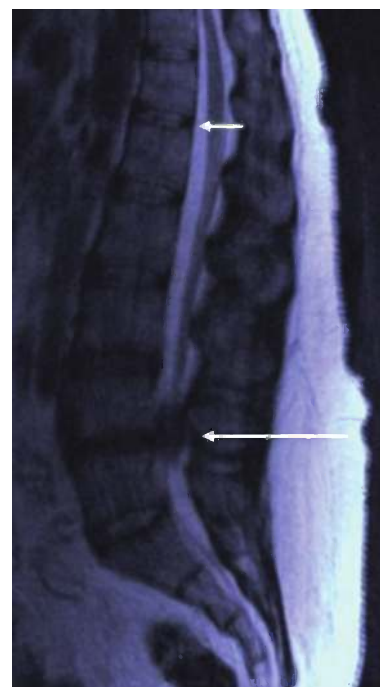


Figure 107.1 The MRI of the clinical case. There is herniation of the L4 disc with compression (large arrow) of the spinal nerve roots (cauda equina). The normal disc position at the T12 level is shown with the small arrow.

choice. Surgical consultation, from either a neurosurgeon or orthopedic spine surgeon, should also be performed. The urgency with which the surgeon decides on operative management is clearly not a decision made by the emergency clinician. Controversy exists within the surgical community regarding the urgency of operation. Most authors agree that early surgical intervention is the best approach, with “early” defined as occurring within the first 48 hours after diagnosis. Other surgeons feel that urgent surgery at the time of diagnosis is the most appropriate. It is widely believed that patients who have earlier operations have decreased neurologic disability. Unfortunately, many patients are left with permanent deficits. In general, the patient is likely to be discharged from the hospital with the same neurologic status present as was noted at the time of surgery.

Further reading

1. Shapiro S. Medical realities of cauda equina syndrome secondary to lumbar disc herniation. *Spine* 2000;25:348–51.
2. Hussain SA, Gullan RW, Chitnavis BP. Cauda equina syndrome: outcome and implications for management. *Br J Neurosurg* 2003;17:164–7.

CASE 108 | Facial Swelling in a Patient with Poor Dentition

Answer: D

Diagnosis: Submandibular abscess (Ludwig's angina)

Discussion: Infection of the submandibular space occurs when a periapical abscess of the second or third molar penetrates the inner cortex of the mandible and gains access to the area inferior to the insertion of the mylohyoid muscles. As the infection tracks posteriorly, the sublingual space becomes involved. Ludwig's angina refers to the resultant cellulitis of the submandibular space, beginning in the submaxillary space and spreading to the sublingual space via the fascial planes. As the submandibular space begins to expand as a result of the cellulitis or abscess, the floor of the mouth becomes indurated and the tongue is forced upward and backward. This can subsequently cause airway obstruction.

Ludwig's angina typically manifests with fever, pain, drooling, trismus, dysphagia, submandibular mass (as visualized in this case), and dyspnea. Airway compromise caused by displacement of the tongue can occur abruptly. Obvious signs of airway obstruction necessitating immediate artificial airway include stridor, dysphonia, and dyspnea. If airway compromise is not imminent and time allows, fiberoptic nasotracheal intubation or tracheostomy, under local anesthesia, should be performed

in a multidisciplinary fashion (ideally in the operating room). Some authors recommend early definitive airway intervention even if there are no signs of airway compromise. Abrupt airway closure has occurred in patients with Ludwig's angina despite careful observation. Published reports document that active airway management in the form of endotracheal intubation or tracheotomy was eventually required in 35% of cases of Ludwig's angina. Computed tomography scans are utilized in select cases to determine the extent of infection if the patient is medically stable, appropriately monitored, and emergent airway equipment is at the bedside. Before antibiotics were available, nearly half of patients with Ludwig's angina died. With broad-spectrum antibiotics and prompt surgical care, the mortality rate now is less than 5%.

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1. Marcus BJ, Kaplan J, Collins KA. A case of Ludwig angina: a case report and review of the literature. *Am J Forensic Med Pathol* 2008;29(3):255–9.
2. Saifelddeen K, Evans R. Ludwig's angina. *Emerg Med J* 2004;21(2):242–3.

CASE 109 | Weakness and Bradycardia in an Elderly Female Patient

Answer: A

Diagnosis: Third-degree atrioventricular block

Discussion: The rhythm strip demonstrates complete independent activity of the atria and ventricles; furthermore, the atrial and ventricular rhythms are both regular with a wide QRS complex. These findings are consistent with complete atrioventricular (AV) dissociation, also known as third-degree AV block.

Heart block is a descriptive term used to characterize a disturbance in the conduction of the electrical impulse in the heart – in this case, in and around the AV node. This disturbance can be partial or complete, resulting in either a delayed or an entirely blocked impulse. In complete heart block, no atrial impulses reach the ventricle through the AV node and intraventricular conduction system. The atria and ventricles are functioning independently with control by different pacemakers. The atrial pacemaker can

be either sinus or ectopic, with a nonsinus focus at normal, slow, or rapid rates. The ventricular rhythm, in essence an escape rhythm, can also have varying pacemaker sites resulting in differing rates; most often, the QRS complexes are regular. The site of ventricular escape rhythm will be immediately below the level of the block. When the ventricular escape rhythm is located near the bundle of His, the rate is greater than 40 beats per minute and the QRS complexes tend to be narrow. When the site of escape is distal to the bundle of His, the rate tends to be less than 40 beats per minute and the QRS complexes tend to be wide, as seen in this case.

In children, the most common cause of third-degree AV block is congenital pathology. In adults, acute coronary syndrome, medication toxicity, and degenerative processes are the most common causes of complete heart block; in fact, acute myocardial infarction (AMI) is the

most frequent etiology of third-degree AV block. Patients with anterior wall AMI complicated by third-degree AV block are likely to be significantly compromised by the bradycardia. The pathophysiology in this setting likely involves irreversible ischemic injury (i.e., infarction) to the intraventricular conduction system. Because the conduction system injury is both permanent and infra-Hisian, medical therapies are unlikely to produce benefit; the response to therapy short of transvenous pacing is limited – these patients should be considered for a transvenous pacing wire and, ultimately, for permanent pacemaker insertion.

Conversely, patients with inferior wall AMI tolerate the block to a greater extent. The ventricular response is usually greater with rates greater than 40 beats per minute seen in most instances. The site of block is higher in the conduction system – either within the AV node or the bundle of His; reversible ischemia to the conduction system complicated by a heightened parasympathetic tone is seen in these patients. If the ventricular rate is greater than 40 beats per minute and the patient is stable, one can elect to place a transvenous pacer only if the clinical situation deteriorates. If the patient deteriorates, transvenous pacing should be initiated.

The prediction of third-degree heart block in the acute coronary syndrome patient remains a significant clinical challenge. One useful method to predict this complication considers the presence of the following ECG findings, including first-degree AV block, second-degree (types I and II) AV block, right bundle branch block, left bundle branch block, left anterior fascicular block, and left posterior fascicular block. Each risk factor, if present on the ECG in the setting of an acute coronary syndrome event, is given a score of 1. The total score is then calculated and translated to the rate of occurrence of such third-degree AV block: 0 with a 1.2% risk, 1 with a 7.8% risk, 2 with a 25% risk, and a score of 3 or more with a 36.4% risk.

Further reading

1. Brady WJ, Swart G, DeBehnke DJ, et al. The efficacy of atropine in the treatment of hemodynamically unstable bradycardia and atrioventricular block: prehospital and emergency department considerations. *Resuscitation* 1999;41:47–55.
2. Lamas FA, Muller JE, Turi ZG, et al. A simplified method to predict occurrence of complete heart block during acute myocardial infarction. *Am J Cardiol* 1986;57:1213–19.

CASE 110 | Lightning Strike Induced Skin Changes

Answer: C

Diagnosis: Feathering

Discussion: The case figure demonstrates a depressed, gray, punctate wound on his shoulder corresponding with an entrance wound with surrounding feathering. Figure 110.1 shows multiple discrete punctate burns along the side of his body where he was in contact with the sleeping bag's metal zipper. Figure 110.2 reveals two depressed punctate lesions on the lateral aspect of his foot and on the end of his great toe, corresponding with exit wounds (known as the "tiptoe" sign).

Cloud-to-ground lightning strikes occur approximately 30 million times each year in the United States. These lightning strikes are associated with approximately 93 deaths and 257 injuries annually. The electrical current generated by a nearby lightning strike will preferentially flow through a person's body rather than the ground. This is called "step voltage." Two skin findings associated with lightning are present in this case. *Feathering burns* are



Figure 110.1 Punctate burns on the patient's side.

most frequent etiology of third-degree AV block. Patients with anterior wall AMI complicated by third-degree AV block are likely to be significantly compromised by the bradycardia. The pathophysiology in this setting likely involves irreversible ischemic injury (i.e., infarction) to the intraventricular conduction system. Because the conduction system injury is both permanent and infra-Hisian, medical therapies are unlikely to produce benefit; the response to therapy short of transvenous pacing is limited – these patients should be considered for a transvenous pacing wire and, ultimately, for permanent pacemaker insertion.

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Further reading

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Figure 110.1 Punctate burns on the patient's side.



Figure 110.2 Punctate burns on the patient's foot (known as the "tip-toe" sign).

pathognomonic of lightning and are not true burns but rather transient skin marks. *Punctate burns* are multiple, discrete circular burns that range in diameter from a few millimeters to a centimeter.

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2. Centers for Disease Control and Prevention. Lightning-associated deaths – United States, 1980–1995. *MMWR* 1998; 47(19):391–4.

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